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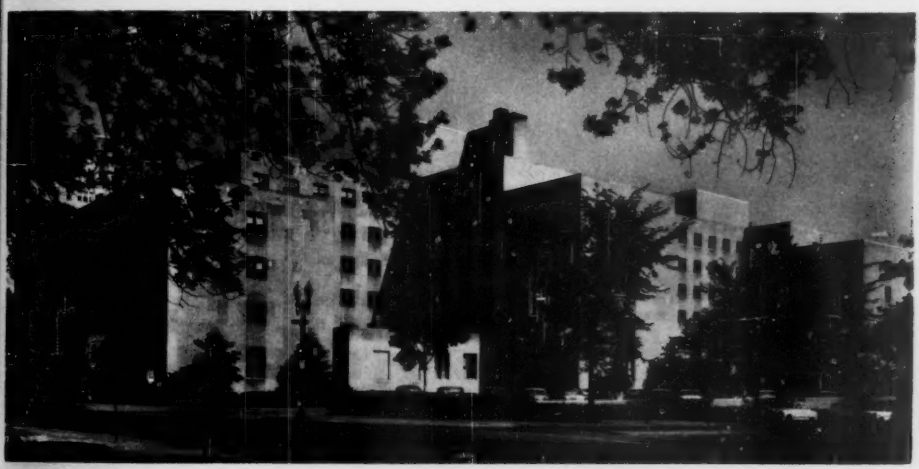
FOREWORD

The privilege of writing a foreword for this issue of *The American Surgeon* is doubly appreciated. It provides an opportunity to thank the Editorial Staff for honoring our surgical faculty with a George Washington University number, and it permits us to record some of the history of surgery as a science in this eleventh oldest of the current schools of medicine in the United States.

It is significant that Dr. James M. Staughton, chemist, surgeon and co-founder of the Medical School, brought from his studies at the University of Pennsylvania and his travels abroad a concept of the importance of the basic sciences to the teaching and practice of surgery. With the founding of the school in 1821, Dr. Staughton assumed academic responsibility for the courses in chemistry and surgery. Thus began the balance between the science and the art of surgery in a new school in the nation's capital.



The George Washington University Hospital, Washington Circle, Washington 7, D. C., part of the George Washington University, Washington, D. C., March, 1960.

For the past half century the educational and research activities of the department of surgery have been directed by three distinguished physicians. Dr. William C. Borden, well known military surgeon, distinguished medical historian and highly regarded educator, was professor of surgery from 1909 to 1931 and dean of the school of medicine from 1909 to 1930. Dr. Charles Stanley White, professor emeritus of surgery, excellent teacher, capable writer, efficient administrator and skillful surgeon, served as professor and chief of service from 1931 to 1946. Since 1946 the department of surgery has been under the able direction of Dr. Brian Blades.

During these past 15 years more advances have been made in medical science than during any similar period in history. Surgeons have contributed immensely to modern medical progress. Scientific surgery applied to an increasing complexity of human illnesses including congenital anomalies, traumatic wounds, and tumorous

growths provides an avenue of health for patients of all ages. Successful operations which were unheard of, or which were in the experimental stage less than a decade ago, are being performed daily in hospitals throughout our country.

Similar to many other university and hospital centers our surgical research laboratory has become an important academic area, alive with ideas which are put to the test of trial, experiment and time. Dr. Blades and the members of his staff have been acutely aware of the need to master and apply those basic sciences which permit them as surgeons to participate completely in the care of their patients.

The scientific papers, reports of research and clinical findings which appear in the George Washington University issue reflect the quality of work which is being accomplished in the department of surgery. These articles illustrate the balance between science and applied surgery which has characterized our school for the past 140 years. They demonstrate that fundamentals of scientific study and sound practice form the foundation for surgical progress.

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SOLITARY PULMONARY ASPERGILLOMA

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A solitary pulmonary lesion caused by Aspergillus is apparently quite uncommon. Aspergillus infections may mimic pneumonia, lung abscess, pulmonary tuberculosis or bronchogenic carcinoma.[4, 5, 6] Scattered reports in the literature, Yesner and Hurwitz,[13] indicate that the Aspergillus presents either as a primary infection or insinuates itself into an area which has already been infected or diseased by some other process.[1, 2, 11] It has been suggested that Aspergillus may be encountered in people who have received antimicrobial or adrenal steroid therapy for other diseases. It has also been reported that Aspergillus may superimpose itself with tuberculous cavities and in patients with bronchiectasis. Hausmann,[4] in reporting a case of pulmonary aspergillosis, indicates that there is a characteristic roentgen appearance of the lesion, which was first described by Levin.[9] He cites a report by Vellios and associates,[12] who have collected 22 cases in which the Aspergillus infection occurred in previously existing pulmonary lesions such as congenital cysts, areas of bronchiectasis, old tuberculous cavities or cavities of pyogenic origin.

One may infer then, that Aspergillus infections may present either as: (1) an acute infectious process; (2) a chronic infectious process; (3) a solitary lesion; or (4) secondary invasion within an existing disease area. Apparently Gerstl[3] was the first to report resection (lobectomy) for this lesion. Since then a number of resections have been reported in the literature and these are briefly summarized in table 1.

TABLE 1

Summary of resections

Author	Age	Sex	Cough	Hemoptysis	Previous Lung Disease	Positive Aspergillus Culture	Resection Performed
Yesner[13]	35	M	Yes	Yes	0	0	L.L.* lobectomy
Hughes *et al.*[8]	56	M	Yes	Yes	Yes	Yes	L.U.† lobectomy
Ramsey[10]	39	M	Yes	Yes	No evidence	Yes	R.U.‡ lobectomy
Hausman[4]	52	F	No pulmonary symptoms mass in L.U.† lobe on x-ray		0	0	L.U.† lobectomy
Foushee[1]	44	M	No pulmonary symptoms, presented as *Aspergillus hematuria*		0	0	R.U.‡ lobectomy
Hochberg *et al.*[7]	48	M	Yes	Yes, repeated profuse	No	0	Anterior segmental L.U.† lobe
Present case	63	M	Yes	Yes	?	0	L.U.† lobectomy

* Left lower.
† Left upper.
‡ Right upper.

The present case report is most interesting since no evidence could be found of pre-existing tuberculosis in this patient. This was based on the purified protein derivative (PPD) skin test. However, there was evidence of extensive bilateral pulmonary fibrosis and bullous formation.

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These areas could conceivably have offered a haven for this organism. This case history, then, is reported in order to shed some further light on this ubiquitous and self effacing organism, and to record it as well. It should be noted that the characteristic x-ray appearance of the lesion as described by Levin was not seen in this case.

CASE REPORT

Mr. W. H., a 63-year-old white man, hospital number 2-024398, was admitted to the George Washington University Hospital on August 10, 1958, with a chief complaint of hemoptysis for the past 3 months. The patient is a maintenance man for the Gas Company. For the past 10 to 12 years he has had half hour episodes of coughing on arising, usually productive of clear saliva-like fluid. However, for the past 3 months sputum has contained bright red blood. There is no dyspnea, fever, weight loss, night sweats, chest pain, fatigue, postnasal drip or shortness of breath and the patient has not been on any medications. The Public Health Service followed him with frequent chest films and told him that he has had old tuberculosis in both lungs. He does not recall ever having had tuberculosis. Eight years before this admission, the patient had had a subtotal gastrectomy for a bleeding ulcer and now has some nausea postprandially. Patient smokes approximately a package of cigarettes a day. Blood pressure is 120/80; respiration, 16; pulse, 80; temperature, normal. Patient is 5 ft. 5 in. tall, weighs 107 lb., is thin, wiry and apparently in no distress. Physical findings are within normal limits. There is no outward evidence of disease. The admission diagnosis was bronchiectasis with questionable tuberculous involvement and the possibility of bronchogenic carcinoma. Patient was admitted to the hospital, where routine sputum cultures were performed for tuberculosis. There was no acid-fast bacillus seen on smear on two separate occasions. The culture was negative on both occasions. The PPD intermediate test was reported as negative. Bronchoscopy and bronchography were performed, both of which were normal. However, a report from the radiologist indicated that there was extensive bilateral pulmonary fibrosis associated with bullous formation, most marked in the upper lobes. There is apparently some cystic change in the upper lobes where they cannot be differentiated from other types of cavity formation. In the absence of any other positive findings, the patient was placed on a regime of postural drainage, nebulization and told to return for follow-up. Patient was again seen in August 1960 because of a repeated bout of hemoptysis. Apparently, the patient had continued to cough up blood after his first hospital admission. The hemoptysis had been intermittent. However, in the past 3 or 4 days the patient has had rather severe hemoptysis and felt that it was necessary to consult his physician again. There is no apparent change in the physical findings except that the patient is 2 years older. Laboratory studies were repeated which showed absence of acid-fast bacillus on smear and culture. Bacteria found within the respiratory tracts were alpha hemolytic strep, pneumococcus and *Neisseria catarrhalis*. The admission urine and blood work were normal and an electrocardiogram taken on admission was within normal limits. The axis,

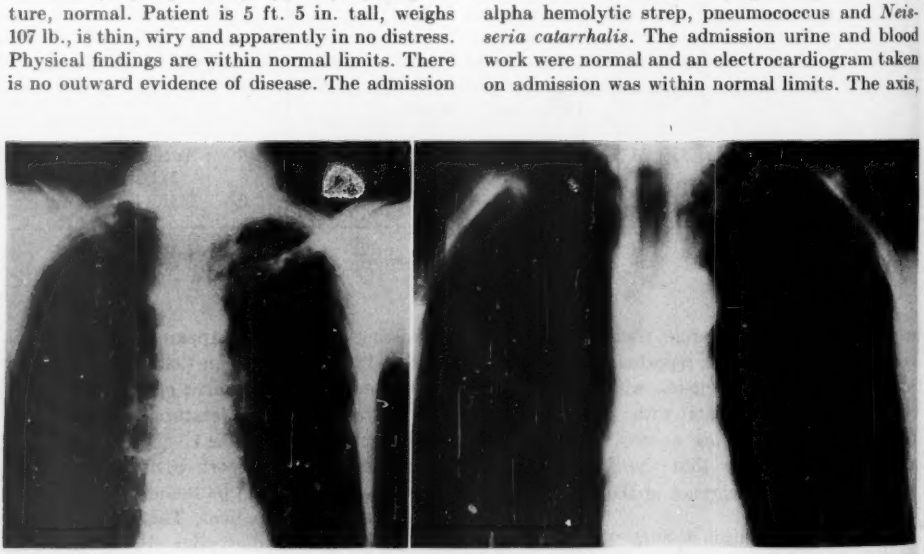

FIG. 1. Chest film showing lesion in left upper lobe

FIG. 2. Microscopic view of aspergillus bodies seen in resected pulmonary lesion

however, was vertical and there was a suggestion of decreasing voltage across the precordial leads which might indicate pulmonary emphysema. Bronchoscopy was again performed and this time clotted blood could be seen coming from the left upper lobe orifice. This was aspirated and given over to the laboratory for study. Again the skin tests for tuberculosis were negative; skin test for histoplasmin was negative as well. Tomograms were taken which showed a 2½- by 3-cm. nodular density in the left apex which apparently was present on the previous admission (fig. 1). On the basis of this it was thought that this either represented a carcinoma, a localized infection or tuberculosis. Pulmonary function tests were performed by Dr. Harold Silver and showed normal vital capacity and maximum breathing capacity. However, the timed vital capacity indicated that there was appreciable trapping and obstruction. It was felt that the patient could tolerate thoracotomy and a lobectomy if necessary. Accordingly, it was explained to him that no definite cause for the lesion could be found, but that since it existed and was of a malevolent nature it should be removed. Patient readily agreed and after a period of convalesence from his second hospitalization he was readmitted on November 10, 1960, at which time a left upper lobectomy was performed. At

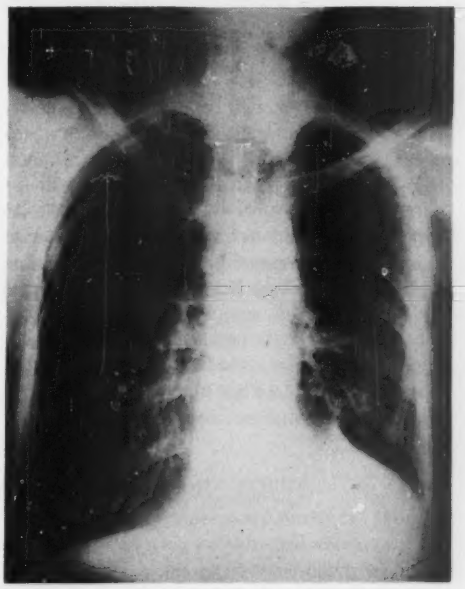

FIG. 3. Postoperative chest film

thoracotomy it was found that the left upper lobe was markedly adherent to the chest wall. Adhesions were lysed by electrocautery, and by extrapleural dissection this large mass was dis-

sected free. It was hard and firm and gave the impression of carcinoma to the operator. The hilum was dissected free and no hilar adenopathy could be found.

The pathologist's report (Dr. William Newman) in essence stated that the specimen was a left upper lobe with a number of prominent emphysematous blebs throughout the surface (fig. 2). The large 5-cm. area of consolidated lung tissue was very firm in consistency and grayish white in color. Upon pressure in this area, a large amount of soft necrotic pinkish material was easily expressed. The space which had been emptied appeared to be a rough cystic cavity approximately 2½ cm. in diameter. Sections of the bronchus leading to this area showed continuity of numerous bronchial segments into the above-mentioned cavity. In addition to the aforementioned necrotic area there were several zones of fibrosis within the lung and rather a diffuse pattern of emphysematous changes, most marked at the apex of this lung. Microscopic diagnosis showed that there was no true abscess wall. The mass appeared to be due to dilated second and third order bronchi with proliferation of the hyphal mass within. Old hyalinized granulomas in lung tissue and nodes may have represented tuberculosis, but there was no active tuberculosis.

The patient has had an uneventful recovery (fig. 3).

SUMMARY

An additional case of pulmonary aspergilloma is reported because of its clinical similarity to upper lobe tuberculous bronchiectasis or tuberculosis with superimposed bronchogenic carcinoma. A short review of the literature is included, and previous resections for this disease tabulated. This is apparently the seventh such case reported.

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PEPTIC ESOPHAGITIS AND HIATAL HERNIA: A FOLLOW-UP STUDY

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Surgical correction of a hiatal hernia, based on the anatomic and physiologic principles defined by Allison,[1, 2] has received wide acclaim in the past decade.[6, 9, 12] Nevertheless, there is considerable lack of agreement concerning the management of the patient with peptic esophagitis accompanying a hiatal hernia.[4, 6, 7, 10, 12, 14, 15] Severe stenosis of the lower esophagus may result from protracted esophagitis and ulceration, but fortunately is not common.[11, 15] On the other hand, mild to moderate peptic esophagitis as demonstrated by esophagoscopy is a frequent finding in the patient with a sliding hiatal hernia.[3, 9, 13] This report concerns a follow-up study on a group of patients with a sliding hiatal hernia and nonstenosing peptic esophagitis, compared with a similar group with hernia, but without demonstrable esophageal changes. The question which we sought to answer was whether the surgical or postoperative management of the patient with peptic esophagitis need be different from that of the patient with a normal appearing esophagus.

From 1954 to 1960, 126 consecutive operations for repair of a sliding hiatal hernia were performed on 125 patients at The George Washington University Hospital. Patients with significant stenosing esophagitis or achalasia of the esophagus as well as a hiatal hernia were excluded from this study. One patient was operated upon a second time for a recurrent hiatal hernia, and another operation for recurrent hernia was performed on a patient in whom the hernia had been initially repaired elsewhere.

Of the patients, 65 were women and 60 were men. The age range (fig. 1) was from 20 to 86 years. The majority of patients were in their fifth through seventh decade of life.

PREOPERATIVE EVALUATION

All patients were examined by upper gastrointestinal radiography. A diagnosis of hiatal hernia was made by this means in 120 patients. Six patients had objective findings of esophagitis, and a hiatal hernia was suspected but could not be demonstrated radiologically. This group will be discussed in more detail subsequently.

Of the 126 patients, 105 were examined preoperatively by esophagoscopy without complication. All esophagoscopic examinations were performed under general anesthesia. Esophagitis was observed in 65 patients (61.9 per cent). There were 32 men and 33 women in the group with demonstrable esophagitis. Analysis of the patients with esophagitis with reference to age showed no particular trend (fig. 1). Esophageal mucosal changes were seen in all age groups without significant predilection for either the young or the aged.

The degree of esophagitis was arbitrarily classified as minimum, moderate, or severe (table 1). This classification was based on the gross changes of the esophageal mucosa as observed through the esophagoscope: erythema of the esophageal mucosa was interpreted as representing minimum esophagitis; marked erythema, edema, and friability of the mucosa, moderate esophagitis; and definite ulceration was classified as severe esophagitis. Five patients in this group with minimum or moderate esophagitis did not have radiologically demonstrable hiatal hernias, but subsequently at operation were found to have considerable dilation and incompetence of the esophageal hiatus. Although there is some question in our minds whether these patients represent a definite hiatal hernia or are examples of simple incompetence of the hiatus with esophagitis, we have arbitrarily included them in this series.[4]

OPERATIVE FINDINGS

All patients were operated upon by the thoracic approach, employing subperosteal resection of the left eighth rib. A sliding type of esophageal hiatal hernia was encountered in 120 patients. In four of these patients, an additional paraesophageal component of the hernia was found. In five instances, there was considerable dilation and relaxation of the esophageal hiatus, although the

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stomach was not definitely fixed above the diaphragm. In none of the patients in this series was there true anatomic shortening of the esophagus, so that in all cases the stomach could be reduced below the diaphragm without serious difficulty. Repair of the hernia in all instances was carried out following the principles defined by Allison. This included dissection of the hernia sac, a counterincision in the diaphragm, anchoring of the phrenoesophageal ligament to the undersurface of the diaphragm, and closure of the hiatus around the esophagus. Postoperative intercostal water-seal drainage was instituted in all cases.

POSTOPERATIVE COURSE

There were two early postoperative deaths, a mortality rate of 1.6 per cent. Both patients died of associated disease. One 61-year-old man had survived three previous myocardial infarctions, and his symptoms of myocardial ischemia and hiatal hernia were difficult to divorce. Hiatal hernia repair was performed with full appreciation of the operative risk. On the third postoperative day, a fourth myocardial infarction occurred, and the patient died the following day. At necropsy, a recent thrombosis of the left anterior descending coronary artery was found. Evidence of previous myocardial infarction was also encountered. The other patient, an 83-year-old man, had been subjected to an intensive work-up for persistent gastrointestinal symptoms. The only positive finding was an extremely large hiatal hernia. Persistent vomiting and severe dysphagia were the main indications for operation. The postoperative course was complicated by bronchopneumonia, heart failure, shock and uremia. The patient died on the ninth postoperative day. Necropsy demonstrated multiple pulmonary emboli and a previously unsuspected carcinoma of the pancreas.

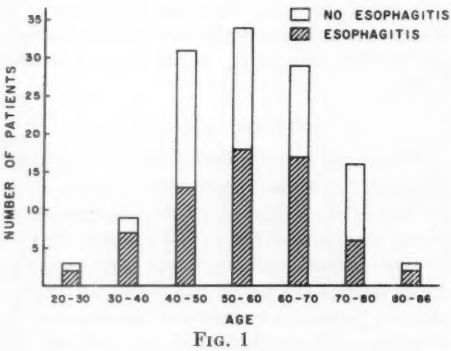

FIG. 1

TABLE 1

Preoperative esophagoscopy (105 patients)

Results	Number	Per Cent
No esophagitis	40	38
Esophagitis	65	62
Minimal	21	
Moderate	30	
Severe	14	

In addition to the two deaths, there were 19 nonfatal postoperative complications, a morbidity rate of 15 per cent. These complications were treated in standard fashion with good results in all instances.

FOLLOW-UP

Subjective. To evaluate the long term subjective results following repair of a sliding hiatal hernia, a questionnaire was sent to all patients who had been operated upon between 6 months and 6½ years previously. Responses were received from 110 of the original 125 patients. In addition to the two early postoperative deaths, there were three late deaths, all unrelated to the operation. Ten patients failed to return their questionnaires and are considered lost to follow-up.

Of the total group of 110 patients, 98 (89 per cent) considered their operation to be a success in terms of alleviation of symptoms. There were 12 patients who did not believe that they had been benefited by the operation. Of this group, 10 reported that their symptoms were about the same, and 2 patients believed that their symptoms were more severe than before operation. Division of the responding patients into those with and without preoperative esophagitis showed a striking similarity of the two groups. Of the 48 patients without demonstrable esophagitis prior to operation, 43 (89.5 per cent) reported that they had obtained symptomatic improvement following repair of the hiatal hernia and were satisfied with the result. Sixty-two patients with varying degrees of esophagitis before correction of the hernia responded to the questionnaire, and 55 (89 per cent) believed that they had obtained a good result from the operation (table 2).

The major residual symptoms in those patients

TABLE 2

Appraisal of late results by questionnaire (110 patients)

Late Result	Preoperative Status	
	Esophagitis	No esophagitis
Symptoms relieved	55(89%)	43(89.5%)
No benefit	7(11%)	5(10.5%)
Symptoms still present	5(8%)	5(10.5%)
Worse	2(3%)	
Total	62	48

who did not benefit from operation were chest pain, eructation and heartburn. These complaints were equally distributed in each group. Three of these patients have known recurrence of the hiatal hernia. A definite recurrence of the hernia has not been demonstrated on the remaining nine patients.

Objective. Radiographic examination of the esophagus and stomach was performed postoperatively in 89 of the 126 hernia repairs. Three patients had developed a demonstrable recurrent hiatal hernia, and one of the three developed a second recurrence. Therefore, four known recurrences followed 129 nonfatal hernia repairs, an incidence of 3 per cent. One recurrence developed more than a year following the initial repair, since radiographic examination one year postoperatively did not demonstrate a recurrent hernia. However, examination of the operative records on all three patients revealed that one patient had developed a periaortic hematoma at the time of operation. The other two patients had no untoward event during the operation and no obvious anatomic reasons for recurrence. It is of interest that all three patients who developed recurrence of the hiatal hernia were very obese. All three also were in the group who did not feel that they had been symptomatically improved as the result of their initial hiatal hernia repair.

Fifteen patients were examined postoperatively by esophagoscopy. Indications for esophagoscopy were postoperative dysphagia (eight patients) and symptoms of esophagitis (seven patients). Six of the eight patients who experienced dysphagia did so in the early postoperative period, and esophagoscopy was performed primarily for dilation. Good results were obtained in all cases. Findings of esophagitis were encountered in 11 of the 15 patients examined postoperatively by esophagoscopy. All but one of these patients had had some degree of preoperative esophagitis. All complained of residual symptoms of esophagitis consisting of heartburn, anterior chest pain and difficulty with highly seasoned food.

DISCUSSION

Evaluation of 126 patients with a hiatal hernia has included preoperative esophagoscopy in the vast majority of instances. Sixty-two per cent of the patients had gross changes of the esophageal mucosa indicative of peptic esophagitis. Stricture formation as a result of esophagitis has been quite uncommon and is not included in this study.

We have been puzzled for some time about the exact significance of these esophageal changes. Analysis of this group of patients demonstrated that esophagitis occurred about equally in men and women, and the incidence did not predominate in any particular age group.[16] In our experience, there has been little or no correlation between the severity of symptoms associated with the hiatal hernia and the presence or absence of esophagitis. In addition, the symptoms appeared to bear little if any relationship to the size of the hernia.

Review of long term results, primarily subjective, following repair of a sliding hiatal hernia showed that approximately 89 per cent of the total group of patients obtained a good result. The morbidity and mortality as well as the results are comparable to other published reports, and the recurrence rate of 3 per cent compares favorably with other reported series.[9, 10, 12, 13]

The operative technique and subsequent management of all patients were essentially the same

regardless of the presence or absence of esophagitis. The long term subjective results in the group of patients with esophagitis were almost identical to those of the group without esophagitis. Both groups had the same frequency of good results (89 per cent), and the residual symptoms were similar in those patients who were not improved. Consequently, it would appear that peptic esophagitis, accompanying a sliding hiatal hernia and without evidence of stricture formation, does not have a significant bearing on the amount of relief afforded by repair of the hernia and, consequently, should not be a critical factor in determining management or prognosis in these patients.

It is apparent that there are as yet many subtle factors in this disease complex which are not well defined or understood. Standard radiographic techniques for visualizing the upper gastrointestinal tract do not seem adequate for evaluation of reflux into the esophagus, especially in the absence of herniation through the esophageal hiatus. Cineradiographic studies would seem to offer a greater degree of accuracy in visualizing the dynamics of the gastroesophageal junction.[5] Perhaps other physiological measurements, such as pressure studies or pH determinations of the gastric and esophageal contents, as advocated by Hill,[8] may afford better information for selection of patients and evaluation of results.

CONCLUSIONS

1. Analysis of a group of 126 patients with hiatal hernias demonstrated that 61.9 per cent had mucosal changes which are generally attributed to peptic esophagitis.

2. Eighty-nine per cent of patients reported satisfactory relief of symptoms when questioned six months to six years after repair of the hiatal hernia.

3. There was no significant difference in the results following hiatal hernia repair in the patients with esophagitis and the patients without esophagitis.

4. The presence of the gross changes of esophagitis without stenosis does not seem to be a significant factor in determining the management or prognosis of a patient with a sliding hiatal hernia.

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AN APPRAISAL OF THE SURGICAL TREATMENT OF PEPTIC ULCER IN A CITY HOSPITAL FOR A 10-YEAR PERIOD, 1951 TO 1960

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During the past 10 years 212 patients have been operated upon for the treatment of peptic ulcer on the George Washington University Surgical Service at the District of Columbia General Hospital. This group of cases forms the basis of this report, and excludes 83 cases of perforated duodenal ulcer operated upon by simple closure during the same period of time.

In table 1 the cases in this series are listed according to location of the ulcer. Duodenal ulcer comprised the largest group with 133 cases, exceeding the gastric ulcer group of 61 cases slightly more than two to one. There were 89 men and 44 women in the duodenal ulcer group and 39 men and 22 women in the gastric ulcer group. Of the entire series, 136 patients were Negro and 76 were white. In addition to peptic ulcer, the series consists of 12 patients with superficial gastric erosion, 4 patients with marginal ulcer and 2 patients with gastrojejunocolic fistula.

In table 1 the indication for surgical intervention for the cases in this series is presented. Gastrointestinal bleeding was by far the most common indication for operation with 137 cases, or 64.6 per cent of the entire group falling into this category. Bleeding was the indication for operation in over two-thirds of the duodenal ulcer cases and about one-half of the gastric ulcer patients. The 12 patients with superficial gastric erosion and 2 of the patients with marginal ulcer were operated upon for upper gastrointestinal bleeding. This high incidence of bleeding, as an indication for operation, is at variance with many reported series where bleeding comprises about 25 per cent of patients subjected to gastric resection for peptic ulcer. The high incidence of hemorrhage reflects the type of patient treated in a city hospital, where many admissions are of an emergency nature. Most of these patients do not seek medical care until a complication of their illness arises, or until late in the course of their disease. These factors are to be stressed in the interpretation of the statistics presented, especially in the mortality statistics. Hinton[5] has indicated the difference in the patient admitted electively with the complaint of tarry stools from the patient who faints after a massive hemorrhage and is brought to the hospital by ambulance. A large portion of our bleeding patients were of the latter type, and practically all of the patients were operated upon on an emergency basis. If the bleeding had stopped and the patient was operated upon later electively, then intractability, rather than bleeding, was considered the indication for operation.

Medical intractability with 53 cases, or 25 per cent of the series, was the second most common indication for operation. Only 14 per cent of the duodenal ulcers were in this group. This is at extreme variance with most reported series in which intractability is the usual indication for operation for duodenal ulcer. About one-half of the gastric ulcer cases were operated upon for intractability. Many gastric ulcer cases were included in the intractable group, being operated upon for gastric ulcers that failed to heal with medical treatment during the period of hospitalization.

Pyloric obstruction was the indication for operation in 12 duodenal ulcer patients and perforation with bleeding accounted for 10 cases. It is the policy of our service to do simple closure for perforated duodenal ulcers, but 10 cases were subjected to gastric resection because of associated gastrointestinal bleeding. Two of the patients with marginal ulcer and the two patients with gastrojejunocolic fistula were listed in the intractable group.

In table 2 the 137 bleeding cases are divided into four categories according to the severity of the hemorrhage. Mortality statistics are indicated for each group. Each category has been defined as follows: Exsanguinating—excessive blood loss in which vital signs fail to stabilize after rapid administration of 2000 cc. of blood. Massive—vital signs were stabilized by blood replacement,

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but the hematocrit levels failed to be maintained with 500 cc. of blood every 8 hours during the first 48 hours after admission. Elderly patients with blood loss that required the replacement of 2500 cc. or more of blood in the first 24 hours to elevate the hematocrit were included in this group. Moderate—no change was observed in the vital signs. The hematocrit level responded to the initial blood replacement, but bleeding persisted longer than 48 hours, requiring less than 500 cc. of blood every 8 hours to maintain the hematocrit. Also included in this group were patients that rebled while in the hospital and were operated upon promptly after blood replacement for the second hemorrhage. Minimal—persistent slow bleeding with occasional episodes of rapid hemorrhage. Blood replacement maintained the hematocrit, but bleeding continued for 3 or more days. After receiving 8 to 10 transfusions, or essentially having their blood volume replaced twice, these patients were considered candidates for operation. Patients in whom there had been two or more bleeding episodes in the past that required hospitalization and transfusion were included in this group if they were readmitted with another bleeding episode. In such patients operations were advised as soon as the hematocrits were brought to normal.

There were 33 deaths in the 212 cases for an over-all mortality of 15.6 per cent (table 3). Any death within one month of the operation or during the period of hospitalization was considered an operative mortality. Twenty-nine deaths occurred in patients operated upon for bleeding, a 21.2 per cent mortality. There were 4 deaths in the nonbleeding group, a 5.3 per cent mortality rate (table 3). These mortality figures are higher than some reported series, but compare favorably with others. Gardner and Baronofsky[4] reported a surgical mortality of 6.4 per cent for bleeding ulcer. Heuer[6] reported a 29 per cent mortality in patients undergoing surgery while actively bleeding, and a 4 per cent mortality rate in those undergoing elective surgery. Fraser and West[7] had a 33 per cent mortality in late surgery for active bleeding duodenal ulcers. Stewart and co-workers[8] recorded a 10.7 per cent mortality for bleeding peptic ulcer cases with early surgery. Welch and Burke[11] reported an 11.8 per cent mortality in all patients with gross hemorrhage from gastric ulcers and a 24 per cent mortality within this same group when the hemorrhage was massive. Palumbo's and Sharpe's[7] mortality for 175 bleeding cases was 9.1 per cent, but only 81 of these were operated upon as an emergency procedure. For 525 patients undergoing elective operations, they recorded a mortality rate of 2.28 per cent.

Comparison of mortality figures is difficult for many reasons. The location of the ulcer is important; bleeding gastric ulcers have a higher mortality rate than bleeding duodenal ulcers. Early operation is associated with fewer deaths than late operation. The type of hospital and the type of patients treated influence mortality statistics, with the hospital treating emergency ambulance-type cases having a higher mortality rate than the hospital treating referral-type admissions. The age of the patient and the presence of associated diseases of major organs also influence mortality figures. Finally, surgical mor-

TABLE 1

Location of ulcers treated by gastric resection with indication for operation

Location	Bleeding	Intractable	Obstruction	Perforation with Bleeding	Total
Duodenal ulcer	94	18	12	9	133
Gastric ulcer	29	31		1	61
Gastric erosion	12				12
Marginal ulcer	2	2			4
Gastrojejunocolic fistula		2			2
Total	137	53	12	10	212
Per cent of series	64.6	25	5.7	4.7	100

TABLE 2

Classification of bleeding—137 patients with associated operative mortality

Degree of Bleeding	Number of Patients	Number of Deaths	Per Cent Mortality
Exsanguinating	15	7	46.6
Massive	53	8	15.1
Moderate	47	12	25.5
Minimal	22	2	9.1
Total	137	29	21.2

TABLE 3

Operative mortality

Type	Number of Patients	Number of Deaths	Per Cent Mortality
Bleeding group.....	137	29	21.2
Nonbleeding group ...	75	4	5.3
Total.....	212	33	15.6

tality figures cannot be compared to medically treated cases, since the latter not only include large numbers of minimal bleeding cases, but several of the surgical cases will represent medical failures and thus be subjected to late operations.

In analyzing our mortality figures, the correlation of deaths to the four bleeding categories appeared significant (table 2). As might be anticipated, the exsanguinating group had the highest mortality with 46.6 per cent. In this group it was clinical impression that none of the patients would have survived without operation. Blood could not be replaced as fast as it was being lost.

A 15.1 per cent mortality in the massive bleeders was considered satisfactory for the type of patients treated in our hospital. It has been our policy to perform early operations in this group of patients if bleeding failed to stop within 48 hours of hospitalization.

The increase to 25.5 per cent mortality in the moderate bleeding group was less than desired. In this category there were many late operations; often the patients first received several days of conservative treatment with blood replacement. Since the bleeding often was not dramatic and rapid, the gravity of the situation was not recognized early, and many of these patients were followed medically for too long a period of time. This high mortality rate also emphasizes the danger of the patient who rebleeds while in the hospital, since they were placed in the moderate group. It has been our policy to operate early upon all elderly patients who have a massive hemorrhage. However, some patients who stopped bleeding were followed and subsequently had another massive hemorrhage that was frequently more severe than the first. The reserve of elderly patients often was not sufficient to tolerate a second bleeding episode for prolonged periods. Perhaps this high mortality in the moderate bleeding group can be interpreted as an indication for stressing early operation in patients with moderate gastrointestinal bleeding. Our high mortality in this group was directly related to delayed operations.

The 9.1 per cent mortality rate in the minimal bleeding group was considered acceptable with only two deaths in this category.

Our mortality statistics did not bear out a higher mortality in the treatment of bleeding gastric ulcer over bleeding duodenal ulcer. It is well recognized that gastric ulcers are apt to bleed more massively than duodenal ulcers. In medically treated series, bleeding gastric ulcer has a much higher mortality rate than bleeding duodenal ulcer.[2, 10] Since our patients were operated upon according to criteria given for the type of bleeding, with early operation being advised in the massively bleeding group regardless of the location of the ulcer, it was anticipated that mortality of gastric ulcers and duodenal ulcers would be essentially equal.

In table 4 the distribution of gastric and duodenal ulcer patients by age in decades is indicated. Most of the patients in both groups fell into the fourth, fifth, sixth and seventh decades. The largest number of duodenal ulcer cases was in the fourth decade and the largest number of gastric ulcer cases was in the fifth decade. It is interesting to note the large number of duodenal ulcers treated in the fifth, sixth and seventh decades. Indeed, duodenal ulcer in our series was twice as common as gastric ulcer in the later decades of life.

Surgical mortality was found to be directly related to the incidence of surgical treatment by age groups. Therefore, the highest incidence of surgical mortality occurred in the older age groups.

TABLE 4

Distribution of duodenal and gastric ulcer patients by age

Decades	Duodenal Ulcer	Gastric Ulcer
years		
20–30	3	2
30–40	14	5
40–50	44	13
50–60	28	18
60–70	26	13
70–80	16	9
80–90	2	1
Total.....	133	61

TABLE 5

Causes of death—33 patients

Operative	Number	Nonoperative	Number
Exsanguinating (ulcer)	6	Coronary occlusion	4
Surgical shock	4	Cerebral vascular accident	3
Peritonitis	3	Bronchopneumonia	2
Pancreatitis	2	Myocardial failure	1
Small bowel volvulus	1	Progressive pulmonary tuberculosis	1
Intussusception	1	Hepatic failure	1
Duodenal fistula	1	Renal failure	1
Gangrenous cholecystitis	1	Pulmonary embolus	1
Total	19		14

The causes of death have been analyzed and are recorded in table 5. Of the 33 deaths, 19 were related either to exsanguinating hemorrhage from the peptic ulcer or to postoperative complications directly related to the surgical procedures. Exsanguination and surgical shock accounted for 10 of these 19 deaths and were considered unpreventable. The remaining 9 deaths were complications of operative technique and, theoretically, were preventable. There were 14 deaths as the result of associated disease processes of vital organs, such as the heart, lungs, kidneys and liver. Most of these cases were in the older age groups where such mortality is to be anticipated.

The most common operation performed was a 75 per cent subtotal gastric resection with a Hofmeister antecolic gastrojejunostomy. This operation was performed upon 163 of the 212 cases. In 18 patients the operation was 75 per cent gastric resection with intestinal continuity re-established by a Billroth I anastomosis. In recent years 12 patients have been operated upon by vagotomy and hemigastrectomy. Table 6 summarizes the operative procedures employed. No attempt has been made to evaluate one operative procedure in relation to another. All have proven satisfactory to control hemorrhage and have given essentially equally good results.

Follow-up information was collected from a representative group of this series. The 5-year period from 1954 through 1958 was selected, thus providing a minimum of a 2-year follow-up. There were 116 patients operated upon during this period; 18 patients died and were considered as surgical mortality. An additional 21 patients

TABLE 6

Operative procedure—212 patients

Operation	Number of Patients
Subtotal resection—Billroth II	163
Subtotal resection—Billroth I	18
Vagotomy and hemigastrectomy	12
Vagotomy and gastroenterostomy	3
Antrectomy (gastric ulcer)	3
Wedge resection (gastric ulcer)	4
Vagotomy and resection marginal ulcer	4
Repair gastrojejunocolic fistula	2
Segmental gastric resection	2
Gastroenterostomy	1
Total	212

died during the follow-up period; all of illnesses unrelated to peptic ulcer or to the operative procedure. These deaths, for the most part, in elderly individuals were to be expected, since so many of the cases in this series were treated in the later decades of life. Forty-four patients were available for follow-up, leaving 33 patients who could not be contacted.

Of those followed, 93 per cent were classified as having a good to excellent result. There was one proven recurrence with a marginal ulcer, which was reoperated upon with a good result. Nine patients, including the patient with marginal ulcer, had evidence of gastrointestinal hemorrhage during the follow-up period for a 20 per cent incidence of rebleeding. This incidence compares with Gardner and Baronofsky,[4] who

had an incidence of 18.6 per cent of recurrent bleeding after subtotal gastric resection. They noted only an 8 per cent incidence of recurrent bleeding when vagotomy had been added to gastric resection. Only the patient with the proven marginal ulcer who had recurrent bleeding was reoperated upon. In none of the other rebleeding cases was the hemorrhage massive, and further surgical treatment was not necessary. Indeed, in several patients, bleeding was recognized only by the passage of one or two tarry stools. In five of the nine patients, the bleeding episode followed the ingestion of several aspirin tablets.

DISCUSSION

The management of upper gastrointestinal hemorrhage is one of the most difficult problems with which the internist and surgeon are confronted. Obviously, each patient must be individualized. In every case it is necessary to proceed rapidly with both diagnosis and treatment. For effectiveness, it is necessary to follow a general policy that is acceptable to the managing team of internists and surgeons.

On the George Washington University Service at the District of Columbia General Hospital all patients with hematemesis and/or melena are admitted to the medical service, except those with exsanguinating hemorrhage who are admitted directly to the surgical service. Prompt surgical consultation is obtained and both services follow the clinical course of the patient. Immediate diagnostic studies include the history, physical examination, complete blood count, bleeding and clotting time, prothrombin time, and Bromsulphalein test. Early x-ray with limited upper gastrointestinal study is obtained as soon as the patient's condition will allow him to be transportated to the x-ray department. If portal hypertension is suspected, esophagoscopy, and frequently splenic pulp pressure, are obtained to confirm the diagnosis. A special chart is instituted that records on one sheet the amount of blood loss, the amount of blood replaced, the pulse rate, the blood pressure, the hematocrit and the blood volume. The pulse rate and blood pressure are recorded in both recumbent and sitting positions. Each observation is recorded and the time it is made is noted. From such observations, the clinical course of the patient can be accurately followed. The value of this "bleeding" chart can not be overstressed.

There are no definite criteria for surgical intervention. The decision to operate upon any bleeding patient is a clinical one and is shared by both the medical and surgical services. About 1 out of every 10 admissions for upper gastrointestinal hemorrhage to our medical service is operated upon to control bleeding.

Operative intervention is advised as rapidly as possible to all patients having an exsanguinating hemorrhage. An exsanguinating hemorrhage is defined as one in which the patient's blood pressure fails to rise from hypotensive levels when 2000 cc. of blood is rapidly infused. Many such patients are obviously losing blood by hematemesis more rapidly than it can be replaced. In spite of early operation in exsanguinating patients, our mortality in this group was 46.6 per cent, indicating the marked hemorrhage and inability to salvage many such patients.

Any patient who is admitted for upper gastrointestinal bleeding that shows altered vital signs with tachycardia and hypotension, or has a hematocrit below 25 per cent, is treated by the rapid transfusion of 1500 to 2000 cc. of whole blood. Previous studies in our laboratory, measuring the blood volume with radioactive chromium (Cr^{51}) tagged red cells, indicated that a hemorrhage usually exceeds one third of the patient's blood volume to produce hypotension in the reclined position, or to cause an immediate fall in the hematocrit by hemodilation.[9] It is on this basis that we assume any patient with hypotension or a low hematocrit, following a rapid bleeding episode, has lost at least one-third to one-half of his blood volume. Therefore, 3 to 4 units of blood are rapidly transfused in attempt to restore the blood volume toward normal. The patient is then followed with frequent hematocrit determinations. If the bleeding has stopped, the hematocrit will rise one or two points with each transfusion, but when the blood volume has been replaced the hematocrit will often jump five to six points. When this rise in hematocrit is observed, or when the hematocrit reaches the 40 per cent range, transfusions are stopped and the patient's clinical course further observed, with transfusions being administered only if necessary to keep the hematocrit around 40 per cent.

If 500 cc. or more of blood are required every

8 hours for the first 48 hours to maintain the hematocrit as indicated, or if hypotension again develops after the initial blood replacement, operative intervention is indicated. Such patients are termed massive bleeders and are subjected to operation on an emergency basis. Elderly patients who require the initial blood replacement of 1500 to 2000 cc., and subsequently require transfusions to maintain the hematocrit or vital signs are followed only for a 24-hour period prior to recommending operation. Since so often elderly patients have disorders of vital organs, tissue anoxia from massive hemorrhage is poorly tolerated for prolonged periods of time.

When a patient is admitted with upper gastrointestinal bleeding and shows no alteration of pulse and blood pressure, transfusions are administered in an attempt to maintain the hematocrit at about 40 per cent. If less than 500 cc. of blood is required every 8 hours, the patient is considered to have a moderate hemorrhage. All cases in this category are observed a full 48 hours and many for longer periods of time before operation is recommended. In this category, as well with patients considered to have minimal hemorrhage, surgical intervention is indicated when the patient's blood volume has been replaced twice, or has received a total of 8 to 10 transfusions. To allow the patient to continue to bleed even at a slow rate is deleterious and, indeed, our high operative mortality in this group attests to the hazard of delayed operation. Frequently, patients with minimal or moderate hemorrhages stop bleeding, only to have a recurrent massive hemorrhage a few days later. We have frequently observed that the second hemorrhage is poorly tolerated, so that in older patients we have often advised early operation in an attempt to avoid the second hemorrhage.

Over one-half of the cases in this series had experienced one or more previous hemorrhages that required hospitalization and transfusion. Thus, it appears that once an ulcer bleeds, the chances of being exposed to the sequela of hemorrhage again are most likely. In defense of a conservative approach to the treatment of upper gastrointestinal hemorrhage is the clinical observation that many patients have a massive hemorrhage as the first indication of peptic ulcer. Indeed, many such patients have no pain, are apt to be obese with wide costal margins, and are of quite a different habitus from the lean, worried patient that develops the medical intractable duodenal ulcer. Since patients of this type have not experienced the pain and disability of a chronic ulcer, they are more apt to express postoperative complaints relative to the morbidity of loss of three-fourths of their stomachs. The chronic ulcer patient, on the other hand, is quite willing to trade his complaints for the usual slight morbidity of a gastric resection.

The role of vagotomy in the prevention of postresection bleeding has not been ascertained. With a limited follow-up we noted a 20 per cent incidence of rebleeding after resection, which is comparable with that noted by others. Fortunately, most of the rebleeding episodes were minimal and did not require further surgical intervention. Gardner and Baronofsky[4] indicated a lower incidence of rebleeding when vagotomy was combined with gastric resection. During the past year we have been performing vagotomy with gastric resection in all bleeding patients and hope in the future to be able to evaluate whether this lowers the incidence of rebleeding after gastric resection for peptic ulcers.

Alvarez and Summerskill[1] noted an association of the ingestion of salicylate compounds with upper gastrointestinal hemorrhage in 47 per cent of their unselected series of patients admitted to the hospital with bleeding from peptic ulcer. In over one-half of our cases of rebleeding after gastric resection, a history was elicited of ingestion of several aspirin tablets for a few days prior to the bleeding episode. The relationship of salicylate compounds to gastrointestinal bleeding can not be determined, but since such compounds are gastric irritants, we advise all patients having a gastric resection to abstain from the use of salicylates.

SUMMARY

An appraisal of 212 patients operated upon for peptic ulcer during a 10-year period on the George Washington University Surgical Service of the District of Columbia General Hospital has been presented.

Gastrointestinal hemorrhage was the indication for operation in 64.6 per cent of the patients.

The over-all operative mortality rate was 15.6 per cent, with a 21.2 per cent mortality in the bleeding patients and a 5.3 per cent mortality in patients subjected to elective gastric resection.

Subtotal gastric resection with a Billroth II type of anastomosis was the most common operative procedure performed.

A 20 per cent incidence of rebleeding after gastric resection was observed. Rebleeding after gastric resection was never massive and often related to the ingestion of salicylates.

A classification, according to the severity of hemorrhage, for upper gastrointestinal bleeding has been presented. The management of patients, including the indications for operation, for each group of this classification has been presented and discussed.

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PRIMARY CARCINOMA OF THE DUODENUM

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Primary carcinoma of the duodenum was first described by Hamburger in 1746. Although the lesion is considered a rarity, an extensive literature has accumulated, especially in the past few decades. This literature reveals a basic unawareness of duodenal carcinoma and consequently, delayed therapy and a poor prognosis.

In a comprehensive review of the literature by Resnik and Cooper[20] in 1956, there were 580 acceptable cases of duodenal carcinoma. Since 1956, 18 cases have been reported to which we add 4, making a total of 602 acceptable cases through 1960 (table 1).[1, 2, 10, 11, 14, 19, 21-23]

CASE REPORTS—THE GEORGE WASHINGTON UNIVERSITY HOSPITAL SERIES

Case 1—L. R. Admitted: 6-15-57. Expired: 8-10-57

An 84-year-old white woman was admitted to the George Washington University Hospital with vomiting of acute onset and of 8 hours' duration. The vomitus contained ingested food early; but later only bile stained fluid. There was no previous history of similar episodes. There were no other associated gastrointestinal complaints.

Physical examination revealed a well developed, well nourished, white woman in acute distress. The head, eye, ear, nose and throat examinations were within normal limits. The lungs were clear to percussion and auscultation. Heart examination showed point of maximal impulse was in the fifth interspace at midclavicular line; there was a grade 3 precordial systolic murmur heard best at the apex. The abdomen was soft and flat with no palpable masses, except for the aorta. The liver, spleen and kidneys were not enlarged.

Upper gastrointestinal series and barium enema were performed revealing nonspecific findings such as colitis and possible colonic polyp.

During her hospital stay, the vomiting alleviated only to return. An exploratory laparotomy was then performed, and a constricting lesion in the terminal duodenum was encountered with local extension of the tumor into the surrounding tissues. A biopsy was taken, which, on frozen section, suggested lymphoma. A palliative gastrojejunostomy was next performed, and the procedure terminated. The postoperative course was progressively downhill, and the patient died on the 26th postoperative day.

Necropsy revealed an annular and constricting lesion in the terminal duodenum, which on microscopic examination was found to be adenocarcinoma of the duodenum (fig. 1).

Comment. This is a case of duodenal carcinoma presenting with symptoms of high intestinal obstruction. The constricting type of growth is easily apparent in figure 1. The x-rays taken on this acutely ill patient were entirely unsatisfactory. She was unable to retain barium during the upper gastrointestinal series, so that visualization of this carcinoma was not possible. It should also be pointed out that for palliation, a duodenojejunostomy should have been performed rather than a gastrojejunostomy.

Case 2—H. J. Admitted: 4-14-56. Discharged: 4-27-56

A 56-year-old Negro man was admitted to the George Washington University Hospital with a 6-month history of midabdominal distress, weakness and a 30-lb. weight loss. The abdominal distress was described as griping with no radiation and with no relation to meals. There was no nausea, vomiting, anorexia, change in bowel habits or melena.

Physical examination revealed a well developed, thin, weak Negro man in no acute distress. Positive findings consisted of an enlarged, smooth and nontender liver, palpable five finger breadths below the right costal margin.

Laboratory studies revealed anemia and achlorhydria. Upper gastrointestinal series suggested a gastric ulcer and a constricting lesion of the third portion of the duodenum (fig. 2).

An exploratory laparotomy was performed, at which time an obstructing lesion of the third portion of the duodenum was encountered. A segmental resection was performed and duodenal-jejunal continuity was re-established. Pathologic examination revealed adenocarcinoma of the duodenum with local invasion of the pancreas and metastasis to 1 of 10 regional lymph nodes. Post-

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operatively, the patient did well and was discharged on the 14th postoperative day.

Comment. It is interesting that this patient gave no history of nausea or vomiting, although the x-ray as outlined in figure 2 and the resected specimen revealed what should have been an obstructing lesion of the third portion of the duodenum. A pancreaticoduodenectomy is preferred to the segmental resection which was performed in 1956 upon this patient. His survival in March 1961 is indicated, but personal follow-up could not be obtained.

Case 3—C. S. Admitted: 2-22-60. Discharged: 3-2-60

A 76-year-old white woman admitted to the George Washington University Hospital with a 2-month history of lethargy, fatigue and anorexia. In the past year she had lost 29 pounds. Jaundice had developed requiring hospitalization, at which time physical findings were essentially negative, except for the icterus.

Laboratory studies revealed jaundice, probably on the basis of extrahepatic obstruction. X-rays revealed a nonfunctioning gall bladder. Exploratory laparotomy was advised but refused.

Approximately one month later, the patient was readmitted to the hospital with a history of further weight loss, anorexia and deepening jaundice; however, there was no history of abdominal pain, nausea, vomiting or food intolerance.

Physical examination revealed jaundice and an epigastric mass, which was firm, nontender and nonmobile. The liver was firm and irregular but minimally enlarged.

Laboratory studies revealed anemia and four plus guaiac stools. The clinical impression was ampullary carcinoma.

Exploratory laparotomy revealed a dilated gall bladder and common duct associated with a tumor mass in the second and third portions of the duodenum. A pancreaticoduodenectomy was performed. Further pathologic studies revealed a 4- by 4- by 3-cm. tumor mass distal to the ampulla extending into the third portion of the duodenum and encroaching proximally upon the ampulla. Microscopic examination revealed invasion of the common duct and one regional node. Postoperatively, the patient had an uneventful course and was discharged on the 14th postoperative day in satisfactory condition.

Comment. This patient presented with the signs and symptoms of extra hepatic biliary tract obstruction. Ampullary carcinoma was considered as the most probable diagnosis. An upper gastrointestinal series was not performed in the hospital. This patient was engaged in normal ambulatory activity as of March 1961.

TABLE 1

Primary carcinomas of duodenum reported up to 1960

Authors	Type		
	Supra-papillary	Peri-papillary	Infra-papillary
Alvarez[2]		1	
Alexander[1]	1		
Kettunen[11]	1		
Jordan[10]		1	2
Marshall[14]			1
Rabinovitch[19]			2
Shellito[21]		2	2
Skalleberg[22]	2		1
Smith[23]		2	
Iovine		2	2
Reported cases through 1956	152	279	149
Totals (602)	156	287	159
Percentage	26	48	26

Case 4—R. B. Admitted: 8-14-59. Expired: 9-25-59

A 70-year-old white woman was admitted to the George Washington University Hospital with a 2-month history of dyspepsia, anorexia and a 12-lb. weight loss. Approximately 10 days before admission, generalized pruritus occurred, and on the day of admission, she noted dark urine.

Physical examination revealed jaundice and a palpable liver. Laboratory studies revealed anemia, jaundice and an alkaline phosphatase of 18.2 units. Roentgen studies revealed a "normal upper gastrointestinal series" and a normal barium enema (fig. 3).

Exploration was deemed advisable and revealed a duodenal tumor in its second portion encroaching upon the ampulla of Vater (fig. 4). Biopsy revealed an adenocarcinoma of the duodenum (fig. 5). A pancreaticoduodenectomy was performed. Postoperatively, the patient had a stormy course developing subhepatic and subphrenic abscesses in addition to anastomotic leaks. She died on the 42nd hospital day. It is to be noted that on reexamination of the normal upper gastrointestinal series postoperatively, duodenal abnormalities were quite evident.

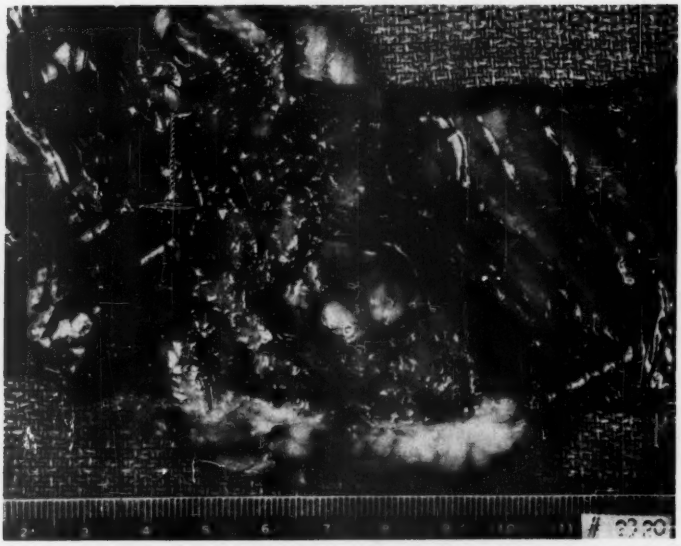

FIG. 1. Autopsy specimen from case 1 showing annular constricting carcinoma of terminal duodenum causing partial obstruction.

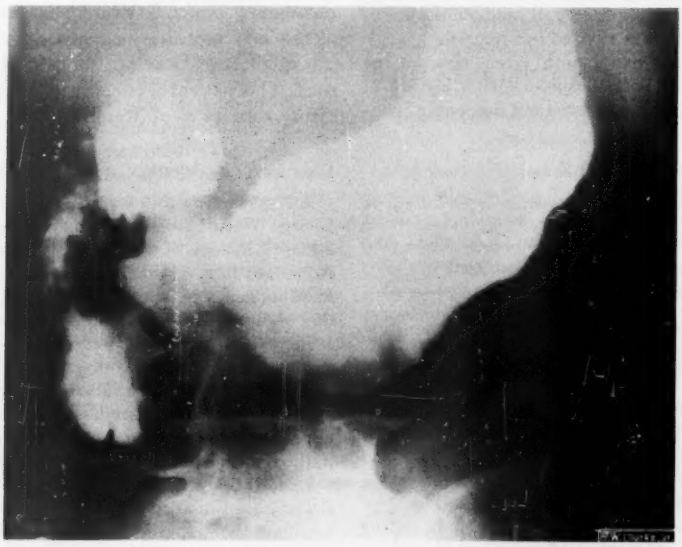

FIG. 2. Upper gastrointestinal series showing constrictive growth in the third portion of the duodenum in case 2.

Comment. It is to be noted in this case that a normal upper gastrointestinal series was recorded. Inspection of figure 3, however, should certainly arouse one's curiosity concerning the widening and displacement of barium which is fairly obvious. A repeat series at least would be indicated. Of interest also is the disparity in microscopic variation between the polypoid portion of the tumor as shown in figure 5 and its extremely malignant base.

DISCUSSION

In the analysis of two large series of autopsies, the general incidence of duodenal carcinoma was found to be 0.03 per cent.[9, 12] Eger found this malignancy to comprise 0.3 per cent of all gastrointestinal carcinomas.[9]

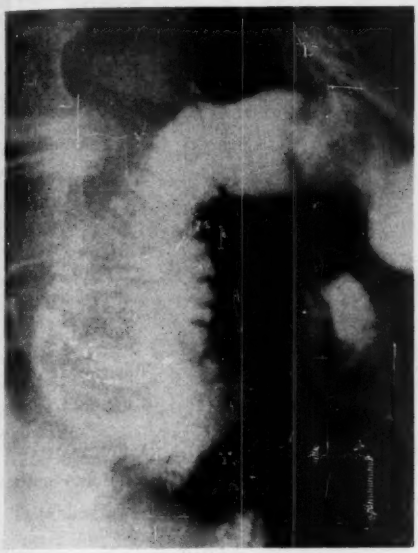

FIG. 3. Upper gastrointestinal series in case 4 originally read as "normal". The descending limb of the duodenum shows widening and suggestive displacement of barium.

In a 12-year period at the George Washington University Hospital, 1115 gastrointestinal carcinomas have been encountered, of which 4 cases were of duodenal origin. Our incidence of 0.35 per cent therefore compares favorably with Eger's (table 2).

Mateer and Hartman[15] divided primary carcinoma of the duodenum on the basis of anatomy into suprapapillary, peripapillary and infrapapillary types. Some authors believe that the peripapillary lesion should not be considered of duodenal origin, since it is very difficult to differentiate a duodenal primary from an ampullary, pancreatic duct or bile duct primary.[5, 8, 20] With all the lesions of the reported cases considered duodenal primaries, approximately one-half of the duodenal carcinomas will be found in the periampullary area, while the remaining one-half will be distributed almost equally in the supra- and infrapapillary areas.

PATHOLOGY

The tumor is an adenocarcinoma, but an adenosquamous type[13] does occur. It is encountered most often in the male in a 3 to 1 ratio,[9] in the sixth decade of life, the average age being approximately 55 years.[24]

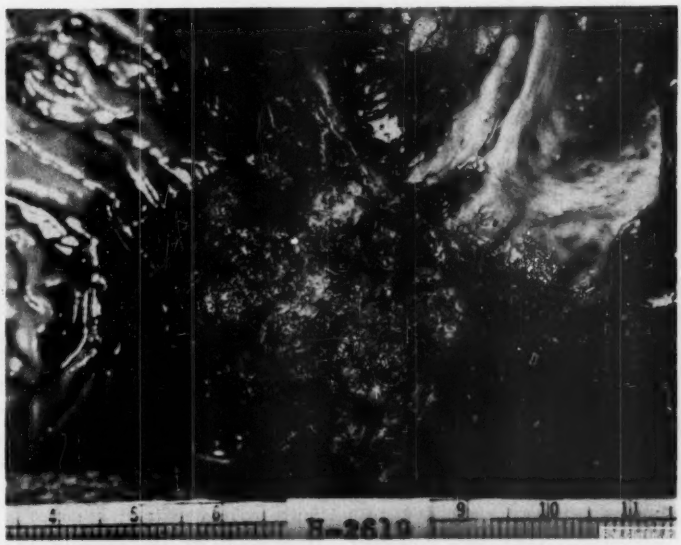

FIG. 4. Portion of the operative specimen in case 4 revealing a polypoid mass with small base near ampullary orifice. The base was a poorly differentiated adenocarcinoma.

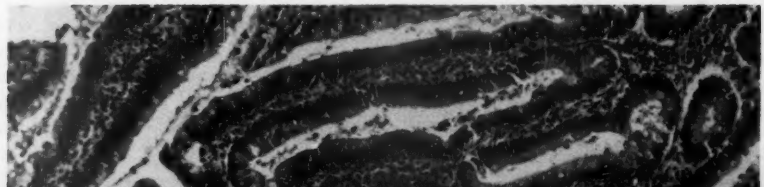

FIG. 5. Section from papillomatous projection of tumor of duodenum in case 4. This well differentiated adenocarcinoma projected from a disorderly, cellular and invasive 1-cm. base.

It generally presents itself in one of three gross types: the scirrhous, the polypoid and the hard colloid type. The scirrhous tumor has an abundance of stroma and few cellular elements. It has a tendency to constriction and subsequent obstruction of the bowel lumen. The large polypoid lesion has an abundance of cellular elements but little stroma. It is soft and has a tendency to necrose and ulcerate with resultant bleeding. The colloid form is a hard tumor with mucoid degeneration.[5, 15, 17]

Metastases are stated to occur late, but will be found in approximately two-thirds of the cases.[5, 10] Metastases first involve the regional lymph nodes, extending through the anterior and posterior pancreaticoduodenal and gastroduodenal lymph nodes to the hepatic chain of nodes, and to a lesser extent to the superior mesenteric chain.[3] The tumor also invades the contiguous structures and finally spreads to mesentery, liver and lungs.

TABLE 2

Carcinomas of the gastrointestinal tract at the George Washington University Hospital, 1948 to 1960

Location	Number of Cases	Percentage
Colon	542	48.5
Rectum	356	32.0
Stomach	205	18.4
Small bowel	12	1.1
Duodenum	4*	
Jejunum	3	
Ileum	5	
Total	1115	

* Incidence of duodenal carcinoma in relation to gastrointestinal carcinoma is 0.35 per cent. Incidence of duodenal carcinoma in relation to small bowel carcinoma is 33 per cent.

SYMPTOMATOLOGY

The symptoms of duodenal carcinoma are varied and inconstant. They are somewhat dependent on both the location and the morphology of the tumor. Weakness, weight loss, anemia and anorexia are commonly present. Epigastric discomfort, pain and vomiting are fairly characteristic.[15] Jaundice is stated to be present in 99 per cent of the peripapillary lesions.[4] Some authors have found obstruction

more common in suprapapillary lesions with hemorrhage common in the infrapapillary types.[16] Others have found obstruction more common in the infrapapillary lesions with hemorrhage and bleeding occurring equally in all locations.[5]

In general, the symptoms will fall predominantly in one of four symptom complexes and will be produced by one of four gross tumor types.[5, 20] These are: (1) obstructing lesions which will produce early satiety, anorexia and vomiting; (2) ulcerating lesions which will bleed and produce weakness, melena and secondary anemia; (3) penetrating lesions which invade the pancreas producing gnawing pain not usually relieved by food or alkali; and (4) lesions which encroach upon the ampulla of Vater or invade the bile ducts producing jaundice suggesting ampullary or pancreatic disease. Again, it must be reiterated that the symptoms of duodenal carcinoma are varied and inconstant and that no clear cut syndrome exists.

DIAGNOSIS

The diagnosis of duodenal carcinoma is seldom made preoperatively. Primary identification is made usually at the time of surgery. In part, this is due to the failure to consider the lesion in the differential diagnosis. Another reason is the lack of specificity of the presenting symptom complex and of the available laboratory studies.

As the problem exists today, roentgen studies appear to be the only consistent method of making the diagnosis, and even this method is limited by the radiologist's awareness of the lesion and his willingness to use appropriate methods to obtain special views. With the routine gastrointestinal series, the middle and inferior thirds of the duodenum are overlooked by the fast passage of barium;[22] similarly, the inferior portion of the duodenum is passed over because it is hidden by the overhanging stomach.[18] It is therefore recommended that small amounts of thick barium be used and that the patient be positioned in the recumbent or in the right and left lateral positions.[22] The study will reveal one or more of the following findings:[5, 16] (1) an annular, infiltrating, or ulcerative defect; (2) alterations in the mucosal patterns; (3) irregular polypoid filling defects that narrow the lumen; (4) dilation of the duodenum above the area of constriction with dilation of the stomach; and (5) rigidity of the duodenal wall.

It is not an uncommon experience, on re-examination of the films after the diagnosis has been established, to find gross irregularities strongly suggestive of duodenal carcinoma (see case 4).

From these observations, one may conclude that a higher index of suspicion of duodenal malignancy under certain conditions would result in more frequent discovery and possibly earlier interception of this lesion. In patients from the fifth decade onward whose complaints implicate the upper digestive tract and do not result from the more commonly demonstrable entities, the diagnosis of carcinoma of the duodenum should be considered. As outlined above, more thorough and possible repeated radiologic examination of this area is probably the best means of exposing the pathology. With experience small bowel biopsy should be of valuable assistance in discovering neoplasia in this area.

TREATMENT

The treatment of duodenal carcinoma is surgical excision. In the literature, this has meant local excision, segmental resection or pancreaticoduodenectomy. The 5-year survival rate following these procedures has been only 5 per cent,[4] the average duration of life being approximately 10 months.[5, 22] These reported figures are misleading since radical surgical therapy is of relatively recent origin. Although authors such as Brown and Brenner[5] have found no significant difference in survival time with the use of palliative and attempted curative procedures, others such as Brunschwig,[6] Cattell and co-workers[7] and Smith[23] have had 5-year survivals with pancreaticoduodenectomy.

Since the growth of this tumor is by direct extension and *via* the lymphatic drainage from the superior and inferior pancreaticoduodenal and gastroduodenal lymph nodes to the hepatic chain of lymph nodes, a block resection, *i.e.*, pancreaticoduodenectomy, should be the treatment of choice. With the advances in anesthesia, in pre- and postoperative care, added to an increased awareness of the physician enabling him to make an earlier diagnosis, an increased number of patients should be amenable to radical

surgery and its increased prospects of longer survival.

SUMMARY

Four cases of primary carcinoma of the duodenum are reported. The incidence of duodenal carcinoma in relation to 1115 gastrointestinal carcinomas operated upon at the George Washington University Hospital is 0.35 per cent. The importance of concentrating on a definitive radiologic study on the entire duodenum in making the diagnosis of duodenal carcinoma is stressed. A pancreaticoduodenal resection is the treatment of choice.

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A SURGICAL CASE OF METABOLIC ACIDOSIS: SUCCESSFUL MANAGEMENT WITH THE USE OF THAM*

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INTRODUCTION

The common denominator of all causes of metabolic acidosis appears to be the inability of the system to prevent a depression in the blood bicarbonate. In shock this situation occurs because of inadequate perfusion of the cell mass with oxygenated blood and the resulting production of excess acid waste products from anaerobic glycolysis.[9, 24] In diabetes mellitus, there is poor utilization of glucose substrate with incomplete combustion of fats and proteins and accumulation of ketonic acids. In renal insufficiency, there is a retention of organic and inorganic acids. In diarrhea and other base-losing diseases, there is a direct loss of blood bicarbonate accompanying the pathologic fluid loss.[17] In severe exercise in the normal individual, a depression in blood bicarbonate reflects an accrued metabolic debt.[2]

Metabolic acidosis can be compensated by the elimination of carbon dioxide *via* the respiratory tract. This mechanism is rapid and effective provided the respiratory system is intact. The pH remains normal. The laboratory data necessary to support a diagnosis of compensated metabolic acidosis are: (1) normal hydrogen ion concentration (pH), (2) lowered blood bicarbonate, and (3) a decreased partial pressure of carbon dioxide. With the passage of time and with adequate renal function, the kidney retains bicarbonate as a further mechanism of compensation, and, therefore, the blood bicarbonate may slowly rise.

We have recently encountered a patient whose history and clinical problem included a chronic compensated metabolic acidosis and whose subsequent hospital course presented some interesting aspects.

From the Surgical Service of the Glenn Dale Hospital, Glenn Dale, Maryland, District of Columbia Department of Public Health. This study was supported by grants from the D. C. Tuberculosis Association and the National Heart Institute.

* Tris (hydroxymethyl) aminomethane supplied by the Abbott Laboratories, North Chicago, Illinois.

MATERIALS AND METHODS

Arterial blood values were obtained by the Astrup[3] microtechnique in which pH and pCO_2 are obtained directly, and HCO_3 determined by interpolation. Oxygen saturation was monitored by the Waters ear oximeter.[25] A depression of bicarbonate below 20 mEq. per L. was considered as indicating metabolic acidosis.

CASE REPORT

M. G., a 106-year-old colored woman, was admitted to Glenn Dale Hospital on July 26, 1960, with a history of ulceration of the left foot since April 1960. There was also a history of mental changes (aphasia, lethargy and incontinence) for the week before admission. Physical examination disclosed frank ulceration and gangrene of the dorsum of the left foot and first three digits. There were no arterial pulsations distal to the superficial femoral arteries bilaterally. There were no localizing neurologic findings to suggest the more common types of cerebrovascular accident. The admission laboratory findings are listed in table 1. Supracondylar amputation of the guillotine type was performed on August 11, 1960, with minimal blood loss. (See table 2 for laboratory findings on the first postoperative day.) The surgical and early postoperative course was without clinical incident. A unit of whole blood was administered 30 hours following surgery at a rate of 125 cc. per hr. During the latter part of the transfusion, the blood pressure rose from 110/60 to 150/90, urinary output markedly diminished, and respiratory rate increased to 40 per min. (See figure 1 for diagram of changes in acid-base balance.) THAM, 116 mEq., was given in 300 cc. of i.v. glucose solution during the hour following the transfusion. The blood pressure immediately dropped to 100/50, and respirations diminished to 30 per minute. Nine hours after administration of the buffer solution, the bicarbonate was 20.4 mEq. per L. Urinary output returned to normal, and the patient remained in satisfactory clinical status. Two days later the bicarbonate was 22 mEq. per L.

TABLE 1

Preoperative laboratory data

Fasting blood sugar	81 mg.%
Blood urea nitrogen	19 mg.%
Sodium	142 mEq. /L.*
Potassium	4.5 mEq. /L.*
Chlorine	129 mEq. /L.*
Urine, specific gravity	1.012
Urine, albumin	2+
Urine, sugar	0
Urine, white blood count	40 to 50 per high power field
Hemoglobin	10 gm. per 100 cc.
Hematocrit	33
White blood count	15,000
Polymorphonuclear leukocytes	84
Lymphocytes	16
Phenolsulfonphthalein	24%—2 hr.

* Milliequivalents per liter.

TABLE 2

Postoperative laboratory data

Hemoglobin	7 gm. per 100 cc.
Hematocrit	28
Total protein	5.2 gm. per 100 cc.
Albumin	2.8 gm. per 100 cc.
Globulin	2.4 gm. per 100 cc.
Sodium	135 mEq. /L.*
Potassium	4.7 mEq. /L.*
Chlorine	120 mEq. /L.*
Urine, specific gravity	1.012
Urine, albumin	0
Urine, sugar	0

* Milliequivalents per liter.

DISCUSSION

It is felt that this patient's preoperative acidotic problem was caused by the gangrenous extremity with superimposed sepsis resulting in the circulation of endotoxins,[1, 21] as well as renal acid retention and/or base loss. Decreased tissue perfusion due to the slightly lowered hemoglobin concentration was probably an additional factor. Her respiratory compensation was quite ample. Manipulation of the leg at surgery probably accounted for the further depression of bicarbonate in the first 24 hours postoperatively (fig. 1). The additional postoperative hemoglobin depression was ascribed to retention of sodium and water and hemodilution. Hemolysis from endotoxin circulation was also considered. The anemia and hypoalbuminemia were worrisome features, nonetheless, and accounted for the decision to transfuse with whole blood. Subsequent to transfusion there occurred a serious further drop in blood bicarbonate[23] which we calculate to be similar to the addition to the system of 90 mEq. of lactic acid. According to Moore, the actual amount added by the ACD blood (National Institute of Health, Solution B) should have been in the neighborhood of 16.8 mEq.[13] It is possible that the transfusion improved perfusion sufficiently to introduce previously withheld acid metabolites into the general circulation. The pH remained normal due to further respiratory carbon dioxide elimination. Oximetry revealed normal arterial oxygen saturation. The immediate use of buffer base restored the laboratory picture to preoperative levels.

It appears remarkable that such a severe acidosis could occur with maintenance of normal pH.[22] Renal shutdown is a well appreciated feature of acute addition metabolic acidosis.[5] There was a transient hypertension during and following the transfusion, probably on the basis of increased blood volume. There was no evidence of cardiac failure. Subsequent to the administration of buffer base, three clinical changes were evident: (1) return to normotensive levels, (2) resumption of urinary output, and (3) reduction in respiratory rate.

To date the screening of a large number of patients has failed to provide us with a clinical sign definitely indicative of an acid-base aberration.[18] There are, however, clinical problems in which metabolic acidosis may be suspected and subsequently confirmed by laboratory procedures. Involvement of multiple organ systems may be present: brain (disorientation, coma), kidney (oliguria, azotemia), heart (arrhythmia,[20] decreased output,[6, 10] arrest), lungs (pulmonary vascular constriction,[4, 12, 14] hyperventilation, bronchospasm),[19] blood (carbon dioxide and bicarbonate ion depressions, potassium elevation, sodium lowering),[16] peripheral vessels (lack of vasoconstriction).[6, 22] Mechanisms of compensation by lung and kidney are well documented in previous papers.[11]

Persistence of severely depressed bicarbonate, even with a normal pH, indicates a precarious state.[7] The degree of respiratory compensation

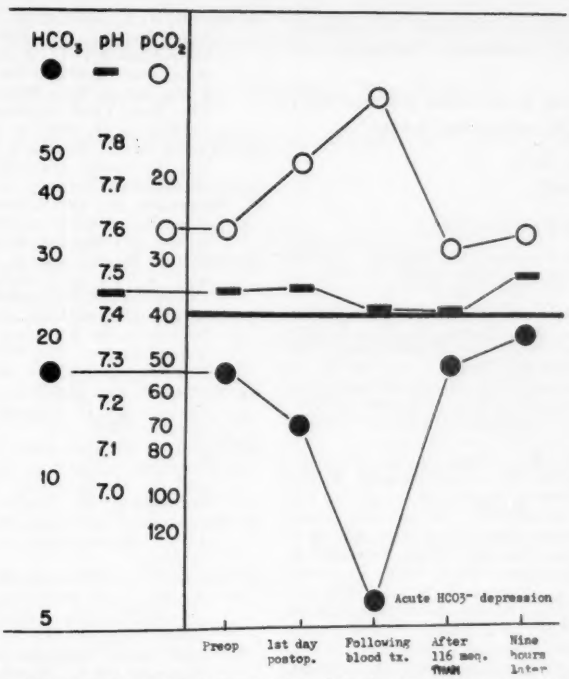

FIG. 1. Illustrates the response of an acute bicarbonate depression to 116 mEq. of THAM. Arterial blood values were obtained by the Astrup microtechnique. The patient's weight was estimated at 30 kg. A modified Singer-Hastings nomogram is on the left. Normal values are indicated by the central horizontal line.

required is such that any additional decrease of buffer base or respiratory insufficiency (pulmonary edema, atelectasis from mucus plug, pulmonary infarction, infection or aspiration) will precipitate a downward shift of pH. Another consideration relative to respiratory compensation concerns the increased work of breathing associated with an accelerated respiratory rate. This additional muscular effort perhaps contributes to an existing metabolic acidosis.[2]

It is our concept that the use of buffers in problems of metabolic acidosis is, in a sense, analogous to the administration of aspirin in reducing the metabolic hazards of pyrectic states. In the latter instance the cause of the fever is not ignored in the physician's therapeutic regimen, but the dangers of its continuation are appreciated. Similarly, it is now recognized that during the acidotic state various metabolic alterations in the body produce a refractoriness to standard forms of treatment. It is the purpose of buffer infusion to restore a more favorable environment for the action of these drugs. Return of pH to normal by the addition of buffer is admittedly a temporary reprieve, in many instances, unless circulatory, endocrine, and respiratory abnormalities are dealt with simultaneously.[8]

It has been our custom in cases of metabolic acidosis to attempt to raise the bicarbonate to a normal level as rapidly as possible. Assuming that extracellular fluid represents 30 per cent of the body weight, this fraction times the base deficit in mEq. per L. gives us the original dose: 0.30 × kg. × (23 − measured bicarbonate ion). Should base deficit remain after this initial infusion, the additional buffer required is calculated at the new bicarbonate level. THAM is given in 0.3 molar solution.

SUMMARY

The problems encountered in a patient with gangrenous extremity are discussed with particular reference to metabolic acidosis.

The hazards of surgical treatment of a patient with compensated metabolic acidosis are emphasized.

The use of THAM is described together with recommendations for calculating dosage.

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THE VALUE OF SURGICAL REMOVAL OF LOCALIZED LYMPHOMAS

II. Evaluation of Roentgen Ray Therapy

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Recently, the authors[6] reported a study of 54 cases of localized lymphomas treated by surgical removal of all disease, roentgen ray therapy alone or surgical removal followed by postoperative roentgen ray therapy.

Briefly, the results indicated that surgical removal of all disease tissue was superior to either roentgen ray therapy alone or surgical excision plus roentgen ray therapy in securing long term survivors free of disease. In a group of 23 patients treated by roentgen ray therapy alone, only 2, or 9 per cent, are presently alive and free of disease, while of 13 comparable patients receiving complete surgical removal of all discernible disease, 12, or 92 per cent, are presently alive and without evidence of disease. In a third group of 18 comparable cases having total surgical excision followed by postoperative roentgen ray therapy, 10, or 56 per cent, are alive and free of disease. Table 1 represents a summary of the results obtained in each of the three groups.

One could logically assume from the statistics presented in table 1 that the surgical extirpation of disease was the factor responsible for the highest survival rates. However, one could also interpret the figures to imply that the addition or singular use of roentgen ray therapy in the manner administered had a deleterious effect on prognosis. This could not be definitely ascertained without analyzing a fourth comparable group of localized cases receiving *no* treatment. Such a group has not been available to the authors.

A question intrinsic to the study is whether the comparatively poor results achieved by roentgen ray therapy alone and the intermediate results secured when used postoperatively could not be due to inadequate therapy. It is this question which the present publication will attempt to answer.

The most outstanding results obtained by roentgen ray therapy in lymphomas have been those reported by Peters and Middlemiss[4] over the past 18 years. In 1942, they published an 88 per cent 5-year survival rate in localized stage 1 Hodgkin's disease. Peters' most recent work,[5] now in publication, places the 5-year survival rate at 66 per cent for this stage disease, which is defined as disease involving only one lymph node group and without systemic symptoms or signs. The method of treatment consists of delivering 1800 to 5000 r (roentgen units) in air (average 3000 to 3500 r) to the involved region using a 400-kv. machine with the factors 0.6 Sn filter, 100 cm. TSD, 5 MA and 1.2 Cu HVL. (In addition, proximal uninvolved lymph node groups are irradiated prophylactically with 1200 to 1500 r.) The prophylactic irradiation to the uninvolved proximal sites has increased the survival rates as much as 20 per cent for 5 years in stages 2 and 3 Hodgkin's disease, they feel.

TABLE 1

Summary—results in localized lymphomas

Statistics	Procedures		
	Surgery	Surgery and x-ray	X-ray
Number localized	13	18	23
Size lesion	4.8 cm.	4.0 cm.	3.9 cm.
Average age	40	58	47
Median age	42	59	51
No. alive and n.e.d.*	12	10	2
Per cent alive and n.e.d.	92%	56%	9%
5-yr. survival rate	75%	79%	32%
5-yr. survivors, disease present	0	4	5
5-yr. survivors, n.e.d.	3	7	2
No. eligible for 5-yr. analysis	4	14	22
Per cent 5-yr. survivors, n.e.d.	75%	50%	9%

* n.e.d. = No evidence of disease.

TABLE 2

Localized lymphoma treated by roentgen ray therapy alone

Patient	Type and Location of Disease*	Present Status		Evidence of Disease	Filter (mm.)		Physical Factors				Portal Size (cm.)	Total r (in air)	Number Exposures	Treatment Schedule	Comment
		Alive (mo.)	Expired (mo.)		CU	AL	KV	HVL	MA	TSD					
1. J. D.	RCS mandible	132		n.e.d.	0.5	3	250	0.9 cu	16	10	6 x 8	2000	8	8 days	
2. N. L.	LS nasopharynx	94		n.e.d.	1.5		250			35	5 x 5	3600 (X4)	12	2 wk.	4 ports
3. E. K.	HD cervical	76		Yes	0.5	3	200	0.85 cu	20	50	6 x 15	2400	13	5d./wk.	
4. D. H.	HD axilla	62		Yes	0.5	3	200	0.9 cu	20	50	6 x 8	3600	12	5d./wk.	
5. C. F.	HD cervical	30		Yes	0.25	1	200	0.8 cu	20	50	10 x 15	4000	10	11d.	2 ports
6. M. F.	HD cervical		94	Yes	0.5	1	200	0.9 cu	20	50	10 x 10	1760			Low doses to multiple regions
7. T. B.	LS tonsil		81	Yes	0.5	1	200		20	50	6 x 8	2750	12	12d.	2 ports
8. F. L.	GFL mesentery		61	Yes	0.5	3	285	3.1 cu	20	50	13 x 13	5000	7	5X/wk.	3 ports
9. J. L.	RCS tonsil		46	Yes	2		400		5	75	7 x 7	6000	30	35d.	2 ports
10. B. S.	LS cervical		40	Yes	0.5	3	220		20	50	10 x 10	2400	12	25d.	
11. E. Z.	RCS axilla		38	Yes	1		200	1 cu	20	30	10 x 15	2500	10	5X/wk.	
12. L. M.	GFL inguinal		36	Yes	1	1	220	1.66 cu	20	50	11 x 17	2000	10	13d.	
13. B. T.	RCS femur		28	Yes	0.5	1	250		15	55	15 x 19	5550	70		3 ports
14. J. G.	HD cervical		27	Yes											
15. A. E.	LS cervical		24	Yes	0.5	3	200	0.85 cu	20	50	6 x 8	3800	12	6X/wk.	2 ports
16. S. G.	LS axillary		24	Yes	1	1	220	1.56 cu	20	50	8 x 10	2000	10	10d.	
17. W. D.	LS cervical		23	Yes	1	1	220	1.56 cu	20	50	15 x 20	3000	36	33d.	
18. A. M.	LS cervical		15	Yes	0.5	3	200	0.9 cu	20	50	8 x 10	5460	26	5X/wk.	2 ports
19. W. W.	RCS cervical		12	Yes	0.5	3	285	1.3 cu	20	50	10 x 10	4360	10	5X/wk.	2 ports
20. A. L.	RCS cervical		10	Yes	0.5	3	200	0.9 cu	20	50	10 x 15	2070	12	12d.	
21. J. A.	RCS cervical		9	Yes	0.5	3	200	0.85 cu	20	50	15 x 15	2300	22	5X/wk.	
22. J. V. A.	HD axilla		7	Yes	0.5	3	200	0.9 cu	20	50	10 x 15	3270	12	5X/wk.	
23. G. R.	RCS axilla		6	Yes	0.5	1	220		20	50	10 x 10	4750	36	33d.	

* RCS = Reticulum cell sarcoma. LS = Lymphosarcoma.
HD = Hodgkin's disease. GFL = Giant follicular lymphoma.

Hynes and Frelich[1] have secured results in the lymphomas nearly equal to those reported by Peters in Hodgkin's disease using essentially the same segmental technique to prophylactic proximal fields. Their reported 5-year survival rate is 80 per cent in 23 stage 1 patients with the various lymphomas using 1200 r to the uninvolved fields, and 1200 to 1800 r to the grossly diseased lymph nodes.

Nice and Sengstrom,[2] however, did not feel that prophylactic irradiation was necessary and used 2000 r over 14 treatment days to the involved nodes. They have secured an average survival in stage 1 Hodgkin's disease of 9.9 years. They conceded that radical surgery followed by postoperative roentgen ray therapy may improve their results even more. Bushka,[3] however, feels that 3000 to 3500 r in a 3-week period or 4000 r in 4 weeks is the minimum dosage necessary to eradicate localized lymphomatous disease. The better results, achieved by surgical removal at certain institutions, he implies, may be secondary to a conservative radiation therapy department in those hospitals.

In order to evaluate more critically our previous results, we have secured and summarized the complete irradiation data on the two groups of patients receiving roentgen ray therapy. The therapy was administered in a number of hospitals, with the majority being treated in hospitals in the local metropolitan area. Tables 2 and 3 present the pertinent factors of this data. The complete data for four patients could not be obtained despite repeated inquiries and communications.

It can be seen that the physical factors, total roentgens in air, portal sizes and treatment schedules are not appreciably different in the two groups for similar locations of disease. Also, the dosages used, with a few exceptions, are those thought sufficient to be lymphocidal by most radiologists. It is noteworthy that of the cases of localized Hodgkin's disease in the roentgen ray therapy only group, 60 per cent have survived 5

TABLE 3

Localized lymphoma treated by surgical removal and postoperative roentgen ray therapy

Patient	Type and Location of Disease*	Present Status		Evidence of Disease	Filter (mm.)		Physical Factors				Portal Size (cm.)	Total r (in air)	Number Exposures	Treatment Schedule	Comment
		Alive (mo.)	Dead (mo.)		CU	AL	KV	HVL	MA	TSD					
1. S. G.	RCS cheek	149		n.e.d.	2		400		5	75	7 x 7	10,000	34	40d.	2 ports
2. M. F.	HD cervical	132		n.e.d.	0.5	1	200		20	50	10 x 10	2600	15	15d.	
3. W. G.	RCS colon	128		n.e.d.	0.1		400	3.2 cu	5	80	16 x 20	1500	10	11d.	
4. E. S.	GFL submaxillary	112		n.e.d.	0.5	3	200	0.9 cu	20	50	4 x 5	2500	10	5X/wk.	
5. D. H.	LS cervical	103		n.e.d.	0.5	3	280		22	50	6 x 8	4000	20	5X/wk.	2 ports
6. G M.	LS cervical	103		n.e.d.											
7. F. D.	HD cervical	99		n.e.d.								3600			
8. B. C.	HD stomach	59		n.e.d.	2		400		5	75	12 x 15	3950	25	43d.	6 ports
9. G. L.	GFL cervical	38		n.e.d.											
10. D. P.	LS inguinal	32		n.e.d.			280	1.45 cu	20	50	15 x 15	2400	12	5X/wk.	
11. C. W.	HD cervical	127		Yes	0.5	3	200	0.9 cu	16	50	6 x 8	3200	16	24d.	2 ports
12. L. S.	RCS inguinal	76		Yes				0.85 cu	20	50	10 x 15	4500	22	5X/wk.	
13. A. B.	LS tonsil	61		Yes	0.5		280	1.4 cu	20	50	10 x 15	4300	16	10d.	
14. L. F.	RCS jejunum	52		Yes	0.5	3	200	0.85 cu	20	50	10 x 15	1000	4	2d.	
15. M. S.	LS stomach		63	Yes	0.5	3	200	0.85 cu	20	50	10 x 15	2100	10	5X/wk.	
16. M. J.	HD axilla		54	Yes	0.5	3	200	0.9 cu	20	50	10 x 10	1500	10	11d.	
17. I. G.	RCS testicle		24	Yes	2		400		5	75	12 x 14	11,800	59	43d.	5 ports
18. J. P.	RCS stomach		3	Yes			280	4 cu	20	50	20 x 20	3900	44	5X/wk.	

* RCS = Reticulum cell sarcoma. LS = Lymphosarcoma.
HD = Hodgkin's disease. GFL = Giant follicular lymphoma.

years or more, which is comparable to Peters' most recent figures. However, *none* of these 5-year survivors were free of disease.

DISCUSSION

Since the patients in the two groups are comparable, and the irradiation given each group is similar, it would seem that the factor improving the survival rates for the group treated surgically was the surgical removal of all disease. We do not feel that the methods of roentgen ray therapy summarized here significantly differ from those methods used in many parts of the country. The dosage schedules employed were, with a few exceptions, those permissible according to the criteria of Hynes, Nice and Sengstrom and others. Prophylactic irradiation to proximal lymph node groups was not used in our cases, which may have altered the prognoses. It is feasible that prophylactic irradiation to proximal disease free lymph nodes is beneficial, although our limited 5-year results in Hodgkin's disease treated with roentgen ray therapy approximate those of Peters.

However, it is important to note that of 22 patients eligible for 5-year analysis and receiving roentgen ray therapy alone, 7 patients survived 5 years or more, of whom only 2 are free of disease. Of 11 patients having surgical removal plus roentgen ray therapy and surviving 5 years, 7 are alive and without evidence of disease. This is an extremely cogent point as it is conceivable that roentgen ray therapy may control the lymphoma for periods of time only to have host resistance ultimately fail, allowing the disease to run rampant once again. The studies of Peters and Hynes do not state whether or not any evidence of disease is present in their 5-year survivors. Perhaps this is one explanation of why oftentimes survivors of 10 to 20 years following roentgen ray therapy suddenly develop active disease.

The effect of roentgen ray therapy on host resistance is of more than academic interest. Olch and co-workers[3] recently showed that sublethal doses of roentgen ray therapy administered to transplanted animal tumors resulted in a significantly higher percentage of distant metastases than in controls. The effects of irradiation on abrogating reticuloendothelial system transplantation immunity is well documented. It is certainly conceivable that irradiation could have more profound effects upon host defense to tumor than on the lymphomatous process. From this small series it would be presumptuous to even

attempt to evaluate what minimum tumorocidal dosages are for these conditions. We believe that these are most pertinent factors which should be investigated.

The question of why one group, treated only by surgical removal of disease, has fared better than similar cases receiving both surgery and postoperative irradiation cannot be answered at this time. One factor may be the shorter period of observation for the former group, 45 months as compared to 74 months for the latter. However, Peters has pointed out the low recurrence of disease after 4 years of freedom from disease which would minimize this as a significant factor. That the roentgen ray therapy in the manner given has been responsible for the poorer prognosis is an intriguing possibility. Presently we are considering a pilot study irradiating transplanted tumors under various conditions in order to evaluate this factor.

SUMMARY

1. Surgical removal of localized lymphomas is an effective means of treating these conditions.

2. Roentgen ray therapy *in the manner administered* is less effective than surgical removal and should be used in this manner only when surgery is contraindicated.

3. The data summarized concerning irradiation dosages and techniques are consistent with those administered in many hospitals throughout the world. It is proposed that institutions achieving greater success with roentgen ray therapy in these conditions should compile and publish their techniques so that the most effective therapeutic approaches could be more accurately determined.

4. The possibility that roentgen ray therapy under certain conditions may be detrimental should be investigated.

5. Survival statistics in these conditions should include the factor of freedom from disease. It is felt that many long term survivors treated by roentgen ray therapy will eventually succumb from latent disease which could have been more effectively extirpated surgically.

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PAPILLARY ADENOCARCINOMA ARISING IN A THYROGLOSSAL DUCT CYST

Report of a Case

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Thyroglossal ducts with resulting cysts and fistulas are well known entities. However, malignancies are only rarely associated with the thyroglossal tract. Of the 10 cases in the world literature of carcinoma originating in a thyroglossal duct cyst, 8 tumors had a cellular architecture similar to the typical thyroid papillary adenocarcinoma.[1, 3-6, 8-10] One follicular type carcinoma with regional submaxillary metastasis was presented by Brentano.[2] A squamous cell type was reported by Nachlas.[7] This is the report of the ninth case of papillary adenocarcinoma originating in a thyroglossal duct cyst.

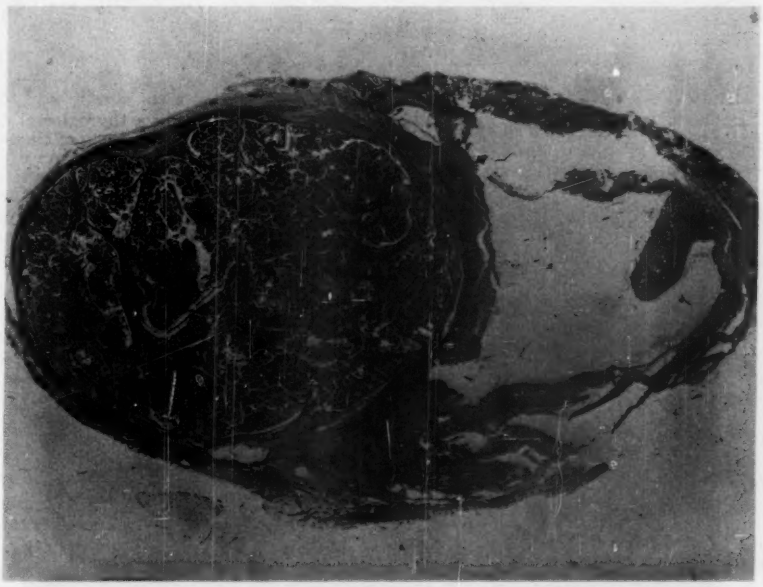

Fig. 1. Papillary adenocarcinoma arising within a thyroglossal duct cyst. × 10

The thyroid anlage begins as an evagination from the floor of the pharynx, midway between the first and second pharyngeal grooves.[8] Early in development, this anlage becomes a hollow stalked structure known as the thyroglossal duct. Its lumen becomes obliterated, leaving a solid cord of epithelial tissue. As the embryo develops, the tongue forms later than the thyroid anlage, and the pharyngeal end of the stalk becomes buried in the base of the tongue at the foramen cecum. Later the hyoid bone develops and passes either anteriorly, posteriorly, or surrounds the duct. The thyroglossal duct extends caudally in the midline of the neck to a point below the thyroid cartilage, where it gives origin to the pyramidal lobe of the thyroid gland. The epithelial lining of the tract then degenerates and disappears.

These embryonic tracts will remain quiescent in the neck for years and then suddenly develop a cyst. Inflammation is probably the initiating

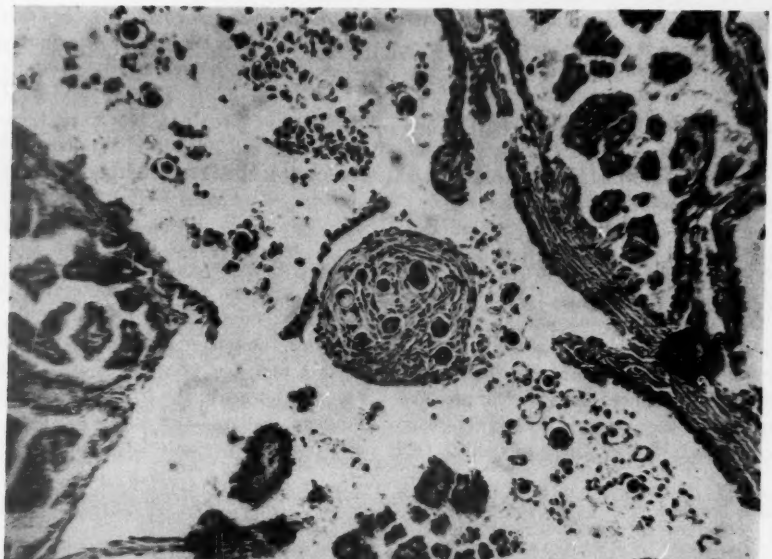

FIG. 2. Higher magnification of papillary adenocarcinoma arising within a thyroglossal duct cyst. Note the papilliform structure and the typical calcospheres within the central island of tissue. × 100.

FIG. 3. Gross specimen

factor in producing a thyroglossal duct cyst.[5] Thyroglossal fistula, or sinus, is rarely a congenital condition but usually develops from spontaneous rupture or incision of an abscess forming within the cyst. The fistula thus formed may be lined with squamous, columnar, or transitional epithelium and may contain thyroid tissue as a residual from the pyramidal lobe anlage. Any of these cellular components could understandably undergo malignant change, yet remarkably few tumors of thyroglossal duct origin are reported.

In 1927, at the Philadelphia Academy of

Surgery, Owen and Ingelby[9] reported the first case of papillary carcinoma arising in a thyroglossal duct. A 44-year-old woman with a 3-year history of a swelling in her neck was first operated on in September 1925. However, part of the stump of the capsule was left. At reoperation in March 1926, the tissue removed was found to be papillary adenocarcinoma originating within the thyroglossal duct cyst. There is no follow-up report of this case.

In 1937, Hugh F. Hare,[4] of the Lahey Clinic, reported the second case, which was that of a 6-year-old boy. Eight months after a radical excision had been performed, the cyst recurred. The pathologic findings, however, were negative for carcinoma at the second operation. The patient was followed for six years and had no evidence of recurrence.

Marshall and Becker[5] reported a case of papillary adenocarcinoma occurring in a thyroglossal duct cyst with no recurrence in 17 years. The five subsequent cases did not have significant follow-up reports.

CASE REPORT

A 58-year-old white man was admitted to The George Washington University Hospital on May 4, 1953, with the chief complaint of a "lump in the neck" of one year's duration. It had been asymptomatic except for some dryness of the mouth during the month prior to admission. The past history and review of systems were noncontributory.

The positive physical findings were limited to the neck where a mass was visible below the mandible in the midline. To palpation it was firm, slightly tender, fixed to underlying tissue, but not to the skin, and moved with deglutition. It had a lobulated configuration and measured approximately 3 by 2 by 1.5 cm. A tract was not palpable and there were no palpable lymph nodes in the neck. The trachea was midline and the thyroid not enlarged.

The impression was that this was a thyroglossal duct cyst. It was excised en bloc up to the foramen cecum including the central portion of the hyoid bone. Pathologic diagnosis was papillary adenocarcinoma of thyroid tissue arising within a thyroglossal duct cyst, as illustrated in figure 1. In figure 2 the tumor is represented in magnification × 100. Note the typical papilliform structure and the calcospheres that are so often seen in papillary tumors of the thyroid. Figure 3 is the gross specimen. The patient was last seen in July 1960, at which time there was no evidence of recurrence of the tumor or of the thyroglossal duct cyst.

SUMMARY

The ninth case of papillary adenocarcinoma arising within a thyroglossal duct cyst has been presented. The patient, a 58-year-old man, has had a 7-year follow-up without recurrence of his malignancy.

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THE USE OF SPLIT THICKNESS SKIN GRAFTS IN PATIENTS RECEIVING ANTICOAGULANTS

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The use of the split thickness skin graft in the patient receiving anticoagulants is a safe, clinically successful and theoretically sound procedure. The split graft is a basic reparative tissue. Its application in wound healing is well known. Its place in the management of a multiplicity of clinical entities is firmly established. Likewise, anticoagulative therapy is widely applied. It is the treatment of choice in numerous vascular derangements. It is extensively prescribed as a prophylactic measure in those cases where thromboembolism must be anticipated. Tissue transplantation and hypoprothrombinemia can be compatible therapeutic measures; clinical advantage should be taken of this fact.[5, 6]

Regrettably, anticoagulative therapy often has been considered a contraindication to operative procedures. For a number of individuals, this concept results either in the discontinuation of much needed anticoagulants during skin grafting, or the adoption of prolonged unsatisfactory conservative management of an open wound in the individual for whom antithrombotic drugs are prescribed. Neither is desirable nor essential. Hemostasis and coagulation are not synonymous terms.

Age, obesity, surgical procedures, infection, cardiac enlargement, auricular fibrillation, occlusive arterial disease, varicosities, dehydration and anemia, as well as trauma, are all conducive to thromboembolism. In individuals predisposed to thrombosis, a variety of situations may arise which require, or are managed with greatest expediency by, a split skin graft. Burns, open mastectomy wounds, colostomy stomas, unhealed amputation stumps and varicose ulcers may all require grafting. Concomitantly in these same patients, the great desirability of prescribing or continuing a course of anticoagulants is readily apparent.[7]

It is the purpose of this paper to relate our clinical experience with the use of the split skin graft in the patient on anticoagulative drugs, and to mention certain other prophylactic measures which should be instituted when the graft is to be used under circumstances in which thromboembolism is prone to occur.

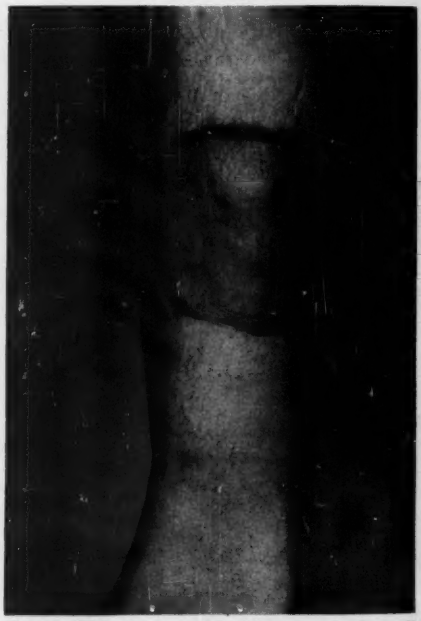

FIG. 1. This 41-year-old white man had a split skin graft taken from the thigh and applied to the leg. The patient received anticoagulants throughout the period of transfer and subsequent bed rest. No technical difficulties were encountered. The graft took well. The donor site healed promptly. Split grafting was done in conjunction with a flap repair of the plantar surface of the foot following an en bloc resection of a large verrucous lesion with benign pseudoepitheliomatous hyperplasia.

In the middle-aged and older individual, the

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FIG. 2. A split graft from the lower right thigh of this 47-year-old white woman was transferred to a denuded area of the left thigh. The patient was given anticoagulants for some 48 days. The graft did well, and the healed donor site was of good quality. No abnormal amount of bleeding was observed clinically at the donor site or beneath the graft. No special care was taken of these areas because of the hypoprothrombinemia.

FIG. 3. This 54-year-old white woman had chronic peripheral vascular disease with deep ulceration of the malleolar area. As part of a reconstructive procedure, a split thickness skin graft was applied to the lower thigh while the patient had hypoprothrombinemia.

FIG. 4. A split skin graft from the thigh was applied to the leg of this 53-year-old white man. His prothrombin time was at therapeutic levels throughout the transplantation procedure. The graft and its donor site healed satisfactorily.

prevention of phlebothrombosis is a paramount consideration in the execution of any reconstructive surgical procedure requiring prolonged bed rest and immobilization. The danger of bed rest is well known, but it can be easily forgotten or disregarded. In one autopsy series, it was shown that simply confining middle-aged and elderly individuals to bed for longer than brief periods of time produced venous thrombosis in some 53 per cent of the patients. Of these patients, 17 per cent had pulmonary emboli; the cause of death in one-third of this latter group was the embolus. The application of a moderate sized skin graft to a thigh, leg, or foot may require two to six weeks of relative bed rest.[3, 4]

Skin grafting is frequently highly desirable in the poor risk patient. Occasionally, it is a necessary and lifesaving measure. It provides a rapid and effective method of converting an open wound into a closed healed surface.[2] Several measures may contribute to the safe completion of the reparative program: (1) a minimal period of bed rest; (2) elastic supports to the leg, which may be applied as an integral part of the pressure dressing used on the donor site or graft of a lower extremity; (3) elevation of the lower extremities; (4) all possible active and passive exercise of the extremity compatible with the grafting procedure; and, (5) anticoagulative therapy. The last has a firm physiologic basis and is a real safeguard against thrombosis.[1]

Before prescribing antithrombotic agents in our initial series of patients, the history was taken carefully; special emphasis was placed on vascular disorders and contraindications to the use of anticoagulants. An initial Lee-White clotting time and the Quick prothrombin time were obtained by the 2-syringe technique.

The hypocoagulable state was initiated with extra high potency heparin, containing 200 mg. of heparin sodium per cc., administered into the anterior abdominal panniculus. A selected coumaric drug was administered concomitantly by mouth; for example, 200 to 300 mg. of Hedulin or Dicumarol. The dose was varied with the weight, age, health and nutritional status of the patient.

Subsequently, heparin was given at 12-hr., and Dicumarol at 24-hr. intervals. The prothrombin time was determined daily until the accepted therapeutic level was reached. While combined heparin and Dicumarol therapy was prescribed, Lee-White clotting times and Quick prothrombin times were checked simultaneously. Thus, any error that might be introduced into the prothrombin time determination by persistence of the effect of the previous dose of heparin could be eliminated.

Coagulation of the blood is only one element contributing to clinical hemostasis and the total hemostatic mechanism. Hemostasis is initiated by the vascular response of the organism. Constriction and retraction of the vessel, decreased pressure, vascular collapse, and agglutination of the vessel wall are all of prime early importance. In the small cutaneous and superficial vessels of the body, agglutination of the intima is sufficient to obtain hemostasis. Coagulation is neither an essential nor necessary part of the process. Thus, on a theoretic basis, it is sound and practical to obtain a skin graft from the individual receiving anticoagulants and apply it to a denuded wound or unhealed ulcer. In our clinical experience, the donor site has not bled significantly in the patient on anticoagulative drugs. At the recipient site, blood has not collected beneath the graft and prevented acceptance of the transplant.

Skin grafting has proven practical in the pa-

tient on anticoagulants with previous embolic episodes, ulceration and other peripheral vascular disease. A pictorial review of our experience with anticoagulative therapy in conjunction with split skin grafting is contained in figures 1 through 4. These cases will serve to illustrate the compatibility of the two therapeutic measures.

SUMMARY

Clinically, it has been demonstrated that the split thickness skin graft can be safely and successfully taken and applied in the hypoprothrombinemic patient. It is theoretically sound.

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WOUND MANAGEMENT IN OPEN FRACTURES

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The open or compound fracture remains a serious orthopedic emergency even today. Proper initial treatment of this condition assumes great importance, because the treatment often determines, to a considerable degree, the ultimate outcome of the injury. Among the civilian population, open fractures constitute a relatively small number of the total. However, in time of war 68 per cent of battle wounds involve the extremities and half of the extremity wounds result in fractures.[5] Management of the open wound has been a challenging aspect of the total fracture problem. In this review we have attempted to correlate the incidence of infection, complications and wound and bone healing with the initial treatment given the patients.

METHOD OF STUDY

An analysis was made of the hospital records of patients with open fracture admitted to the orthopedic service of the District of Columbia General Hospital between January 1, 1955, and December 31, 1960. Information was extracted from the records concerning the initial method of treatment, development of infection or other complications, use of internal metallic fixation, administration of antibiotics, the mechanism of injury and the anatomic site of fracture. Open fractures secondary to gun shot wounds and those which did not remain on our service long enough to observe wound healing have been excluded.

DATA

There were 83 patients who had a total of 85 open fractures (table 1). Two patients presented with bilateral fractures of the tibia. The greatest majority of patients, 43 (51.80 per cent), were injured in automobile accidents either as passengers or pedestrians. The next largest group, which numbered 23 patients (27.71 per cent), resulted from falls either at home or in the street. Fourteen patients (16.86 per cent) were victims of aggravated assault. One each (1.21 per cent) was injured in a sporting, an industrial and a train accident (table 2).

After debridement as the initial procedure, the wounds of 36 of the fractures were left open (table 3). Thirty-three of these wounds were debrided in the operating room; 3 were simply dressed and casted. In this group, (8.33 per cent) became infected. Primary wound suture was utilized in 49 fractures. In some of these cases, Penrose drains were inserted and removed in 48 to 72 hours. There were 17 (34.08 per cent) infections in this group.

Further analysis revealed that internal metallic fixation was applied at the initial procedure in seven patients; of these, three (42.85 per cent) became infected (table 4). There were no infections among five patients who had internal metallic fixation as a delayed procedure after the wounds had healed.

Antibiotics were administered prophylactically to all but six patients. There were no infections among these six. Five wounds were treated by open technique, one by closed. The 20 infections occurred among the remaining 77 patients who received so-called prophylactic antibiotics.

Analysis of fracture healing was possible in 57 of the 85 fractures. These were followed to bony union or nonunion. Results are summarized in table 5. Thirty-four of these fractures occurred in the tibia and fibula and are further analyzed in table 6. The time required for bony union in the tibiae and fibulae managed by the open technique averaged six weeks less than those treated closed. Twenty-two other fractures followed to bony union were too widely distributed for statistical significance.

DISCUSSION

In the past 30 years, there have been several phases of care for the open wounds of fractures.

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TABLE 1

Anatomic distribution of 85 fractures in 83 patients

Location	Number	Per Cent
Humerus	7	8.24
Elbow	5	5.88
Radius and ulna (shaft)	4	4.71
Wrist	3	3.53
Femur	6	7.05
Knee	1	1.18
Tibia and fibula (shaft)	49	57.64
Ankle	10	11.76
Total	85	100.00

TABLE 2

Mechanism of injury in 83 patients

Cause	Number	Per Cent
Automobile accidents	43	51.80
Falls	23	27.71
Aggravated assault	14	16.86
Industrial accident	1	1.21
Sports accident	1	1.21
Train accident	1	1.21
Total	83	100.00

TABLE 3

Incidence of infection in 85 fractures

Method of Wound Management	Number Treated	Number Infected	Per Cent
Open	36	3	8.33
Closed	49	17	34.08

The antiseptic treatment of wounds was practiced widely for a time. The wounds were left open and dressed two or more times daily. The antiseptics used were numerous and varied. This method was characterized by slow healing with abundant granulations and was frequently complicated by secondary infection.[11]

Another phase, the closed plaster treatment, was introduced by Orr[9] and later used extensively by Trueta.[10] After the wound was debrided, gauze was laid between the walls of the wound and the extremity was immobilized in plaster. Essentially, this technique demonstrated the importance of ample debridement and drainage, immobilization and the prevention of secondary infection. It further demonstrated the disadvantages of repeated dressings with antiseptics. However, healing was still by granulation and was delayed.

There was a period early in World War II when the topical application of sulfa preparations into the wound was advocated.[6] The soldier

TABLE 4

Fate of internal fixation

Procedure	Number Treated	Number Infected	Per Cent
Primary	7	3	42.85
Delayed	5	0	
Total	12	3	25.00

TABLE 5

Comparison of healing time in 57 fractures

Location	Open		Closed	
	Number	Mean healing time—weeks	Number	Mean healing time—weeks
Humerus	1	Non-union	2	8.50
Elbow	2	8	3	9.66
Radius and/or ulna	1	6	3	8
Wrist	1	9	1	8
Femur	1	18	1	16
Knee			1	36
Tibia and/or fibula	14	17.07	16	23.43
			4	non-union
Ankle	2	7.5	3	10.33
			1	non-union

TABLE 6

Comparison of time required for bony union in 34 fractures of tibia and fibula

Management	Number	Mean Time—Weeks	Median Time—Weeks
Open	14	17.07	17
Closed*	16	23.43	23.5

* There was nonunion in 4 fractures.

carried a small package of sulfonamide which he applied to his wound at the time of injury. Later, after the wound was debrided, more sulfonamide was sprinkled and the wound closed by suture. This method was later abandoned. Wounds sutured over caked sulfonamide frequently gave complications.

The last phase is also based on the general principles of debridement, drainage, immobilization and prevention of secondary infection, but differs in that the wound is closed after four to seven days. This concept of wound management was first employed to a limited extent at the end of World War I with one essential difference. Bacterial cultures were taken from the wound when it was exposed for dressings and closure was not scheduled if the bacterial count was high. Such a program involved several dressings, each of which afforded new opportunities for infection and required considerable laboratory work.[2]

In World War II this concept of delayed closure was utilized, based on clinical criteria. Closure was accomplished in four to seven days after wounding, by suture or skin graft if the wound looked clean, and providing there was not excessive loss of tissue, dead space or excessive tension required to close the wound. The success of this method is reflected in the fact that by June 1944 in the Mediterranean Theater of Operations, 25,000 soft tissue wounds had been closed in this manner with 95 per cent healing without loss of life or limb or without serious complication.[2] Following this success, this principle was applied to the management of compound fractures also with success.

Between December 1, 1944, and March 1, 1945, 3053 compound fractures were received and treated at the 15th Hospital Center (European Theater of Operations). Delayed primary wound closure was undertaken in 2241, approximately 75 per cent of the total. Eighty-seven per cent of these wounds healed satisfactorily. The percentage of absolute failure was only 7.6 because healing occurred spontaneously, or later secondary closure was successful in another 5.4 per cent of the cases after failure of the first attempt at suture. The incidence of osteomyelitis was 7.6 per cent.[3]

Military surgeons[1] and many civilian surgeons have adopted the principle of delayed primary closure. Our experience indicates that the rate of infection is reduced and the incidence of serious complication is less if we follow this principle, although there are still many who advocate primary closure of open fracture wounds.[4, 7, 8] The added protection of antibiotics is usually given as the factor which makes this possible. But when one considers the infection rate of 8.33 per cent in those left open as opposed to 34.08 per cent in those closed, the difference is significant. In addition, we have found that many of the relatively simple civilian wounds healed satisfactorily without having to be sutured; this is a feature not often seen in the extensive and deep combat wound. Another technique occasionally employed was the simple placing of wire sutures and tying them when the wound was inspected and found to be clean between the fourth and seventh to tenth day. We regard as significant the fact that two-thirds of the 20 fractures that became infected developed osteomyelitis.

It was further interesting to note that three out of seven cases with primary metallic fixation became infected. Five cases in which metallic fixation was delayed until the wound healed did not become infected. Although the number of patients is small, it would seem that internal fixation of the fracture is best carried out after wound healing has been accomplished.

The combination of penicillin and streptomycin was administered prophylactically to the vast majority of our patients. The six patients who did not receive antibiotics did not develop infections. We do not advocate prophylactic antibiotics. A culture taken at the time of debridement or when evidence of infection occurs, provides the necessary information for appropriate antibiotic therapy.

CONCLUSION

On the basis of our experiences with 85 open fractures in 83 patients, we feel that open treatment or delayed primary closure rather than primary suture of the wounds offers a better opportunity for bone and soft tissue healing without infection or serious complications. Further, we believe that internal metallic fixation should be applied as a delayed procedure after the wound has healed. Antibiotics should not be given prophylactically but on the basis of need. The success of "getting away" with wound closure in several patients is certainly

offset by the often disastrous consequences of even one patient who develops osteomyelitis.

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PENETRATING THORACIC WOUNDS

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Penetrating wounds of the chest, both military and civilian, have been compared and contrasted by Blades,[5, 7] Shefts,[15] Valle[17] and others. Most of the studies of these wounds in civilian life have naturally concentrated on injury to specific structures such as the aorta[1, 2, 13, 16] and the heart,[3, 4, 8, 10-14, 16] since these are the potentially lethal injuries.

It seemed to us that a broader perspective might be provided by an analysis of all the penetrating thoracic injuries treated at a large city hospital over a period of years. We have, therefore, reviewed the experience of The George Washington University Surgical Service with penetrating thoracic wounds at The District of Columbia General Hospital, during the 6-year period from July 1954 to July 1960.

This hospital is operated by The District of Columbia Public Health Service, and one of three sections is staffed by the medical and surgical services of The George Washington University. The hospital cares for indigent residents of the District of Columbia. The total bed capacity is 1400, of which some 50 are allocated to The George Washington University Surgical Service. This service admits about 800 patients, and performs about 1100 major and minor operations each year. The patients are treated by residents on the general and thoracic surgical services under appropriate supervision.

Two hundred and thirty-five patients with penetrating thoracic wounds were admitted to The George Washington University Surgical Division at The District of Columbia General Hospital during this 6-year period; 217 had been stabbed in the chest; 18 had been shot in the chest; 32 were also wounded in other parts of the body, 15 of whom were separately wounded in the abdomen, 13 had received multiple thoracic wounds, and 4 had been additionally wounded in other parts of the body.

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WEAPON AND TYPE OF INJURY

In general, women stabbed with ice picks and household knives, but men preferred large pocket knives. Stabbings greatly outnumbered gunshot wounds, a characteristic feature of penetrating thoracic wounds in civilian life (table 1).[13, 15] The location and number of wounds varied widely, but there was a distinct predilection for the precordial area (table 2). The types of injury produced fall into nine groups, and are listed in table 3.

TREATMENT

In 95 patients there were no complications, and the patients were discharged after local care of the wound and 24 to 48 hours' observation.

In 35 patients, minor complications developed that required more extensive treatment and longer periods of observation. In 16 of these, minor operations were required to control chest wall bleeding; 5 developed hematomas of the chest wall that required no treatment; 7 developed subcutaneous emphysema in the absence of demonstrable pneumothorax; and 7 developed miscellaneous complications such as pneumonia, hemoptysis, unexplained fever and so forth, which required a longer period of treatment.

Twenty-one thoracic and two thoracoabdominal wounds were complicated by pneumothorax which was unassociated with hemothorax. Nine were treated by closed thoracostomy and water seal drainage; eight solely by thoracentesis, and six were simply observed. Prophylactic antibiotics were administered. If a pneumothorax was less than 20 per cent, intrapleural air was allowed to absorb spontaneously. If greater than 20 per cent, thoracentesis, or preferably closed thoracostomy and water seal drainage were employed. Tension pneumothorax was initially aspirated, and closed thoracostomy performed as soon as equipment was available. If air flow through the tube and water seal bottle was persistent, suction was applied.

TABLE 1

Type of weapon

Weapon	Number of Cases
Stab wounds	
Knife	201
Ice pick	6
Coat hanger	1
Nail	1
Glass	2
Razor	1
Unknown	5
Gunshot wounds	
Pistol	16
Shotgun	2
Total	235

TABLE 2

Location of penetrating wounds

Type and Location	Number of Wounds
Thoracic	
Right side, anterior	64
Right side, posterior	12
Left side, anterior	137
Left side, posterior	21
Midline anteriorly	1
Thoracoabdominal	
Left side	7
Right side	3
Separate abdominal	15

TABLE 3

Type of injury

Injury	Number of Injuries
Uncomplicated chest wall injury	95
Complicated chest wall injury	35
Pneumothorax	23
Hemothorax	30
Hemopneumothorax	23
Thoracoabdominal	10
Separate abdominal	15
Cardiac	11
Thoracic aortic	2

Thirty of the thoracic wounds were complicated by hemothorax which was unassociated with pneumothorax. Nineteen patients were treated by thoracentesis, and two were simply observed. Eight required operative treatment; two for massive bleeding from gunshot wounds of the thoracic aorta, two for continuous bleeding from small systemic arteries, and one because of the development of an intrathoracic false aneurysm of the subclavian artery. In three other cases, emergency thoracotomy was done because of associated cardiac wounds. One patient died of exsanguinating intrathoracic hemorrhage from a stab wound of the heart, before effective resuscitative treatment could be started.

Thoracentesis was the preferred treatment of hemothorax. Thoracic intubation was not used because of the high incidence of resultant empyema.[6] Aspiration of as much blood as possible was performed as soon as possible, and was repeated as often as necessary. Whole blood replacement was governed by amount of blood recovered by thoracentesis, vital signs, roentgenograms and blood volume studies. Following cessation of intrathoracic hemorrhage, repeated daily thoracenteses were usually required in order to recover all free intrapleural blood. Prophylactic antibiotics were administered.

Twenty-three thoracic wounds were complicated by hemopneumothorax. Ten were treated by thoracentesis, nine by combined thoracentesis and closed thoracostomy, and one was simply observed. Three required emergency thoracotomy; one of these had a pneumopericardium, and suspected cardiac wound in addition. Combined anterior superior closed thoracostomy for removal of intrapleural air and thoracentesis for removal of intrapleural blood was the preferred treatment of hemopneumothorax. Rapid expansion of the lung was usually achieved by this combined approach. Prophylactic antibiotics were administered. Closed thoracostomy and water seal drainage was considered an important safeguard if laparotomy was required for associated injuries.

Ten patients sustained thoracoabdominal wounds. Five were gunshot wounds, and five were knife wounds. Seven were wounded in the left side, and three in the right (table 2). Suspicion of perforation of the left leaf of the diaphragm was an absolute indication for emergency abdominal exploration. Suspicion of perforation of the right leaf was a relative indication, because of protection afforded to other abdominal viscera by the liver.[15] All 10 patients who sustained

thoracoabdominal wounds underwent exploratory laparotomy. One other patient, thought to have a thoracoabdominal wound of the liver, was explored and found to have cardiac tamponade from a right atrial wound. The rapid enlargement of the liver preoperatively was due to congestion from the tamponade, complicated by the effects of overtransfusion.

Continuous gastric suction was started as soon as abdominal injury was evident. Preoperative and postoperative antibiotics were administered. Endotracheal anesthesia was administered in order to avoid complications from pneumothorax following exposure of diaphragmatic wounds. A vertical abdominal incision was used in 10 cases, and a right thoracoabdominal incision in one. Diaphragmatic wounds were satisfactorily repaired by the abdominal approach after the anesthetist immobilized the diaphragm with a paralytic agent. Abdominal injuries were repaired in the usual fashion. A thoracic tube was placed into the pleural cavity on the involved side in each case. Postoperatively, every effort was made to maintain pulmonary expansion in the hope that the incidence of empyema would be reduced.

In 15 patients, exploratory laparotomy was required for penetrating wounds of the abdomen, associated with, but separate from, similar wounds in the chest.

Eleven patients sustained stab wounds of the pericardium and heart. One patient, mentioned previously, died within five minutes of admission of exsanguinating hemothorax from a stab wound of the heart. In one patient, the knife penetrated the pericardium, but did not injure the heart. A hemopneumothorax and pneumopericardium resulted. Nine patients showed evidence of cardiac tamponade, either on admission, or following the use of intravenous fluids. Pericardiocentesis was attempted in six of these patients. It was initially successful in three, but tamponade recurred in each case. Only one patient was successfully managed by pericardiocentesis alone, all the others required thoracotomy at which time cardiorrhaphy, evacuation of blood clots, and suture of severed internal mammary vessels, or other sources of continued bleeding, were done as indicated.

TABLE 4
Indications for thoracotomy

Indications	Number of Cases
Severe hemorrhage (gunshot wound of thoracic aorta)	2
Continued hemorrhage (smaller systemic arterial wound)	2
Development of intrathoracic false aneurysm of subclavian artery	1
Failure of conservative treatment of hemopneumothorax (large residual hemothorax)	2
Large hemothorax and suspected cardiac wound	3
Cardiac wound	6
Total	16

RESULTS

Six deaths occurred. One patient was moribund on admission, and died of exsanguinating hemorrhage from a stab wound of the heart before effective treatment could be started. The other five were postoperative deaths. Fifteen patients underwent thoracotomy, and one a right thoracolaparotomy. The indications are listed in table 4. Of these, two died, both of cardiac arrest following massive hemorrhage from gunshot wounds of the thoracic aorta. In both cases, thoracotomy control of hemorrhage and cardiac massage were unsuccessful. Twenty-five patients underwent laparotomy, and one, already mentioned, a right thoracoabdominal exploration. Three patients died following laparotomy, two of them had thoracoabdominal wounds. One of these patients sustained a shotgun wound which bled profusely from injured left lung, left kidney, spleen and diaphragm. Colon and small bowel were also extensively injured. Following laparotomy and splenectomy, cardiac arrest occurred in the operating room, and was unsuccessfully treated by open massage. The other patient sustained a thoracoabdominal gunshot wound which included the spinal cord and resulted in paraplegia. Initial splenectomy, diaphragmatic repair and closed thoracostomy were successful. However, seven days later, massive upper gastrointestinal hemorrhage necessitated emergency gastrectomy. Cardiac arrest occurred during the procedure, and was unsuccessfully treated by open massage. In the last case death occurred as a result of a separate abdominal wound, perforation of the colon, and overwhelming peritonitis (table 5).

TABLE 5

Mortality statistics

Group Classification	Number of Cases	Number of Deaths	Percentage
Thoracotomy	15	2	13.
Laparotomy	25	3	12.
Thoracolaparotomy	1	0	0.
All operations	41	5	12.
Thoracic wounds	235	3	1.3
Total mortality from all causes	235	6	2.5

TABLE 6

Major nonfatal complications

Complications	Number of Cases
Cardiac arrest	2
Damage to central nervous system	1
Empyema	5
Abscess—lung and subphrenic	1
Fibrothorax	1
Traumatic aortic right ventricular fistula	1
Total	11

There were 11 major nonfatal complications (table 6). Cardiac arrest occurred in two patients just prior to operative release of cardiac tamponade. Both patients were successfully resuscitated. One of these patients who had been in shock for several hours before operation had evidence of central nervous system damage postoperatively which cleared gradually, but completely. Five empyemas occurred. Three followed thoracoabdominal wounds, and two followed hemopneumothorax. All five obtained satisfactory results following thoracic drainage. One patient developed both a lung and a subphrenic abscess following a thoracoabdominal wound. Conservative management of the lung abscess and drainage of the subphrenic abscess effected a satisfactory result. One patient developed fibrothorax following unsuccessful needle aspirations of a hemothorax. He declined decortication. One patient developed an aortic right ventricular fistula as a result of a stab wound of the heart. The fistula was successfully closed using cardiopulmonary bypass 1 month after the emergency cardiorrhaphy. This case has been reported in detail elsewhere.[16]

The time spent in hospital ranged from 1 to 104 days, with an average of 7 days. Of the survivors, the patient who developed fibrothorax was the only long term therapeutic failure.

DISCUSSION

Perhaps the most striking finding in this review is that, in spite of the intent implied by the predominantly precordial wounds, so few serious injuries resulted. One hundred and ninety-four patients, 82 per cent of the total, were successfully treated by simple resuscitative measures alone. In the remaining 41 patients, resuscitative measures were not enough, and a major operation was required for adequate treatment. These figures reaffirm the great importance of the resuscitative phase, emphasized by Shefts,[15] in the treatment of patients with thoracic wounds.

In order of frequence, the main indications for operation were: intra-abdominal injury in 25 patients, (75 per cent), cardiac injury in 9 patients, (22 per cent), and thoracic aortic injury in 2 patients, (5 per cent).

Thoracotomy was used almost exclusively in the treatment of cardiac wounds for many reasons. First, in one patient, the cardiac injury was discovered at operation for a supposed liver injury. Second, in three patients there was associated extensive intrapleural bleeding. Third, pericardiocentesis has not been effective as a definitive treatment of tamponade in our hands. It was attempted in six cases, failed completely in three, and was followed by recurrence of tamponade in three. Five of these patients were operated upon. An additional indication for operation in two patients was the necessity for laparotomy for penetrating wounds of the abdomen. Definitive cardiorrhaphy, control of chest wall bleeding, and water seal drainage of the pleural cavity were felt to be important safeguards against recurrence of intrapericardial or intrapleural hemorrhage during laparotomy. A successful result was obtained in each of the nine patients operated upon. There was no mortality.

The most serious injuries were those involving the thoracic aorta. Both of our patients died in spite of prompt treatment. Lacerations of the great vessels and the heart without tamponade are perhaps the only absolute indications for emergency thoracotomy. In such cases, opera-

tion does not follow resuscitation, but is an integral part of it, as stressed by Beall.[1]

SUMMARY

An analysis is made of 235 cases of penetrating wounds of the thorax, seen between 1954 and 1960 at a large city hospital.

The great majority of the wounds were in the precordial area, but serious injuries were few. One hundred and ninety-four (82 per cent) of the patients were successfully treated by simple resuscitative measures alone.

In 41 patients a major operation was required. The main indications were penetrating wounds of the abdomen, heart, and thoracic aorta.

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RESECTION FOR PULMONARY TUBERCULOSIS: RISK AND RESULTS IN A VULNERABLE POPULATION

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In spite of modern advances, pulmonary tuberculosis remains a serious disease in vulnerable segments of the population. In this group, pulmonary resection is frequently indicated, but is associated with higher morbidity rates than usually encountered in the general population.[1] A review of our experience with resectional therapy supports this finding.

The clinical material was selected from patients treated at the pulmonary disease division of The District of Columbia General Hospital. The hospital is a public institution serving a predominantly Negro indigent population. In this community, the incidence of pulmonary tuberculosis is high, and the disease is virulent. The resultant morbidity reflects racial predisposition, poor health and nutritional status, and the prevalence of chronic alcoholism. At the time of detection, the extent of lung involvement is generally far advanced. Approximately one-third of all original treatment cases fail to achieve target point status despite aggressive medical regimes, and require surgical intervention. In addition, many patients, in whom the disease is controlled, suffer the effects of destructive parenchymal and endobronchial disease necessitating extirpation.

CLINICAL MATERIAL

During the period January 1, 1953, to December 31, 1958, 55 patients were treated by pulmonary resection (table 1). The youngest was 20 years of age, and the oldest was 58 years of age. Of the patients, 9 were white and the remainder Negro. The average age of male and female white patients was 50 and 44 years, respectively; of male and female Negro patients, 41 and 33 years. The average duration of preoperative chemotherapy (combinations of para-aminosalicylic acid, isonicotinic acid hydrazide and streptomycin) was 1 year and 4 months, varying from 2 to 30 months. Eleven patients failed to respond to therapy and continued to show a positive sputum. Bacteriologic studies in these cases revealed virulent organisms with resistant strains. Diabetes mellitus, chronic alcoholism, unwillingness to cooperate with proposed long term medical therapy, and socioeconomic factors frequently prompted a decision for early surgery.

The indications for surgery were persistent cavitary disease (open positive or open negative), destroyed pulmonary segments, residual caseonecrotic lesions, and bronchiectasis (table 2). All patients were bronchoscoped prior to surgery to rule out active endobronchial disease. In most cases, the disease could not be adequately resected by any procedure short of lobectomy (table 1). Concomitant thoracoplasty was performed in seven instances. One patient required a secondary resection of the right middle and lower lobes because of persistent positive sputum and bronchiectasis following upper lobectomy.

RESULTS

There were no operative deaths; 33 patients had an uneventful postoperative course; and 21 patients suffered complications (table 3). The incidence of bronchopleural fistula was 10.9 per cent, and that of empyema (including those associated with fistulas), 14.5 per cent. Five patients (9.1 per cent) died in the postoperative period. In three instances, death was related to the development of a bronchopleural fistula. One patient died as a result of severe bilateral bronchopneumonia; another of a brain abscess secondary to an empyema. Table 4 correlates the preoperative sputum status with morbidity and mortality.

There were only two severe postoperative hemorrhages, and both were managed conservatively. Residual air space did not present any difficulty, responding promptly to closed drainage with suction. Atelectasis was corrected by bronchoscopy and nebulizations with bronchodilators.

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TABLE 1

Operative procedures

Procedure	Number
Pneumonectomy	7
Lobectomy	31
Segmental resection	9
Lobectomy and segmental resection	6
Wedge	2
Total	55

TABLE 2

Indications for pulmonary resection

Indication	Number
Persistent cavitary disease	19
Bronchiectasis and cavitation	11
Destroyed segment, lobe or lung	10
Caseonecrotic lesion	10
Bronchiectasis and necrosis	3
Bronchiectasis	2

TABLE 3

*Complications following pulmonary resection**

Complication	Number
Bronchopleural fistula	6
Empyema—with bronchopleural fistula	5
Empyema—without bronchopleural fistula	3
Atelectasis	7
Spread of disease	3
Severe hemorrhage	2
Residual air space	2
Wound infection (nontuberculous)	2
Pulmonary edema	1
Other	4

* Fifty-five procedures.

The three surviving patients with a bronchopleural fistula required thoracoplasty to close the fistula. Under the classification "others" are included two cases of homologous serum jaundice and two episodes of transient psychosis.

Follow-up from 3 to 72 months was obtained in all 49 patients discharged from the hospital. At the time of follow-up, 43 patients (87.7 per cent) were inactive and well; 5 were still active.

TABLE 4

Correlation of preoperative sputum status with morbidity and mortality

	Patients
Positive sputum	11
Bronchopleural fistula	3 (27.3%)
Died	3 (27.3%)
Negative sputum	44
Bronchopleural fistula	3 (6.8%)
Died	2 (4.5%)

One patient died 1 year after surgery from undetermined cause. Only 2 relapses occurred, and both developed within the first year of surgery. One patient responded to a second course of drug therapy, but the other was still active and receiving therapy.

DISCUSSION

The results reveal a higher morbidity and mortality than reported in recent series.[1, 3, 4, 6, 9, 10] Our findings confirm the experience of others, that tuberculosis in Negroes, particularly in the adult male, remains a serious disease.[1] All five deaths occurred in Negro patients, four of whom were males with far advanced disease, and three had positive sputum with resistant organisms.

Bronchopleural fistula was the most important postoperative complication, and resulted in the death of half of the afflicted patients. Pneumonectomy carried a 14.3 per cent mortality in contrast to 3.2 per cent for lobectomy. This high figure is not surprising since the majority of the operations were performed as salvage procedures for far advanced disease.

In contrast to the low mortality following lobectomy, upper lobectomy together with superior segmental resection of the lower lobe resulted in a 33.3 per cent mortality (2/6). Bronchopleural fistula also occurred in 2 of the 6 cases as compared to an incidence of 2 of 31 when lobectomy alone was performed. Although the number of cases is small (6), it is likely that tuberculous tissue was cut into during dissection of the intersegmental plane, thereby increasing the likelihood of complications. In these cases, pneumonectomy may well have been the procedure of choice.

Correlating preoperative sputum status with morbidity and mortality reveals that the incidence of fistula was four and one half times

greater in positive sputum cases, and was associated with a six and one half times greater mortality. These findings substantiate the importance of adequate preoperative chemotherapy and conversion of a positive sputum prior to resection. The conversion of a positive sputum not only suggests a controlled phase of the disease, but also implies that one is dealing with sensitive organisms susceptible to chemotherapeutic coverage during the operative and postoperative periods.

Despite the increased risk, the results of resectional therapy are far better than those of collapse procedures,[5, 7, 12] or medical therapy alone.[2, 8, 11] Eighty-eight per cent of the patients who survived the operative period (or 78 per cent of all patients operated) were restored to good health. There were only two relapses. Of the patients still active, three represented a breakdown of remaining foci of disease; one due to spread at the time of surgery, and one due to a postoperative bronchopleural fistula.

SUMMARY

A series of 55 pulmonary resections for tuberculosis in a vulnerable indigent population is presented and the results discussed.

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TUBE JEJUNOSTOMY IN TREATMENT OF RECURRENT SMALL BOWEL OBSTRUCTION

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Few problems are more trying to the abdominal surgeon than that of recurrent small intestinal obstruction due to adhesions. Although glove powder, trauma, drying of peritoneal surfaces, infection and hematoma formation are known to increase the likelihood of adhesion formation, it is clear that a natural tendency exists in some patients to form dense fibrous bands between loops of bowel, omentum, or mesentery, even after the simplest abdominal procedures. This is not harmful unless by fixation, constriction, or torsion of intestinal loops it results in obstruction. The latter requires further surgery, with more adhesions and obstruction, until the patients, often addicted to narcotics, become afflicted with a recurrent, debilitating, incurable disease.

Early attempts to treat this condition centered about finding a way to prevent adhesions, or to dissolve them once they were formed. Papain,[8] aminotin and many other substances were employed without success. It was not until Noble,[7] in 1937, suggested, after lysis of adhesions, that the denuded intestinal loops be sutured together in ladder formation, to form controlled adhesions, which could not kink, that any real progress was made. Results of this procedure, reported by Noble,[7] Barron and Fallis,[2] Smith[10] and Poth and co-workers[9] have been encouraging. The operation has been time consuming, however, when the plication procedure is added to the lysis of many adhesions, and obstruction has occasionally occurred in spite of the fixation of the loops.

In 1955 White[11] suggested a method of controlling adhesions to prevent kinking after lysis of multiple bands, by threading a long intestinal tube, already passed into the jejunum, down through the denuded loops to the terminal ileum. A vein stripper was used for introduction of the tube and the tube was left in place for 10 days. Loops of bowel became readhered in gentle curves which prevented obstruction. White reported satisfactory results in 12 of 14 patients in whom it was employed.

We have used this method in four patients with a variation, suggested by Bricker,[4] that instead of threading a long tube through the nose, down to the terminal ileum, we have passed it into the intestine at operation from a point above the denuded bowel, down to the terminal ileum. The proximal end of the tube was brought out through a stab wound in the flank and attached to suction.

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TECHNIQUE

By careful dissection, all adhesions are divided and denuded areas on the bowel wall closed as well as possible. A long no. 16 Cantor tube, with the balloon cut off, is then tied securely to the end of a Webb vein stripper. Through a small incision in the bowel proximal to the denuded areas, the tip of the vein stripper is passed through loop after loop of small intestine to the ileocecal valve. Here a second small incision is made, and the head of the vein stripper is pulled out, slowly advancing the tube into the intestine. The distended loops should be emptied with a long suction tube before passing the vein stripper into them. Deflation will further be aided by cutting small holes into the Cantor tube at 3-inch intervals as it is drawn into the intestine, and keeping the tube on suction. When the tip of the tube reaches the terminal ileum, the vein stripper is cut off, the second bowel incision closed and the tube allowed to lie in place. A chromic catgut purse-string suture is placed about the tube at the proximal incision, the tube brought out through a stab wound in the lateral abdominal wall, and the intestine sutured snugly up to the peritoneum at its point of exit. Care must be taken to avoid spillage, and gloves are changed before closing the abdomen. The tube is placed on low suction, and removed after 10 days. This usually obviates

the need for a Levin tube, and after a few days the patient can be allowed a liquid diet. Suction is stopped after 5 or 6 days, the tube simply lying in the bowel as a splint.

CASE REPORTS

Case 1

A 36-year-old white woman was hospitalized during the night of January 2, 1960, for a cesarean section. Her pregnancy was at full term, the membranes had ruptured 12 hours before admission. Pelvic delivery was not possible because of cephalopelvic disproportion. On January 3, 1960, a classical section was performed because of dense adhesions caused by a previous myomectomy.

Postoperatively, the patient developed gradually increasing abdominal distention. Small amounts of gas were passed by rectum without relief. She began vomiting dark brown fluid on the third postoperative day. There was little or no abdominal pain. Her temperature rose to 101.2°, pulse to 110. Bowel sounds were absent. The abdomen was distended, tympanitic and there was moderate generalized tenderness. On x-ray examination both large and small intestine was distended. Fluid levels were present in the erect film.

A diagnosis of paralytic ileus was made and the patient was treated conservatively by intubation, fluids, electrolytes and hot packs to the abdomen. The distended loops of the small bowel decreased slightly but increased again in size and less and less gas could be seen in the colon on x-ray examination. Leukocytes rose to 14,000 on the 5th postoperative day with 35 per cent segmented forms, 40 per cent bands, 19 per cent lymphocytes and 6 per cent monocytes. Serum chlorides were 100.8 mEq. per L.; CO_2, 22.2 mEq. per L.; sodium 140 mEq. per L.; potassium, 4.6 mEq. per L.

Because of increasing distention and the de-

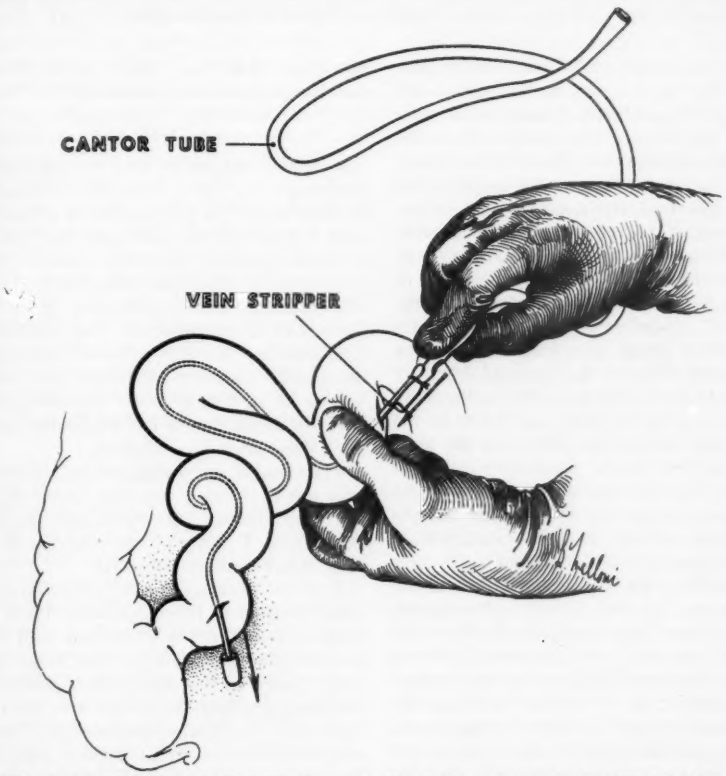

FIG. 1. The distal end of a long Cantor tube, with the balloon removed, has been tied securely to the distal end of a Webb vein stripper. The leading end of the vein stripper has been passed into the small bowel above the denuded area, and brought out just above the ileocecal valve.

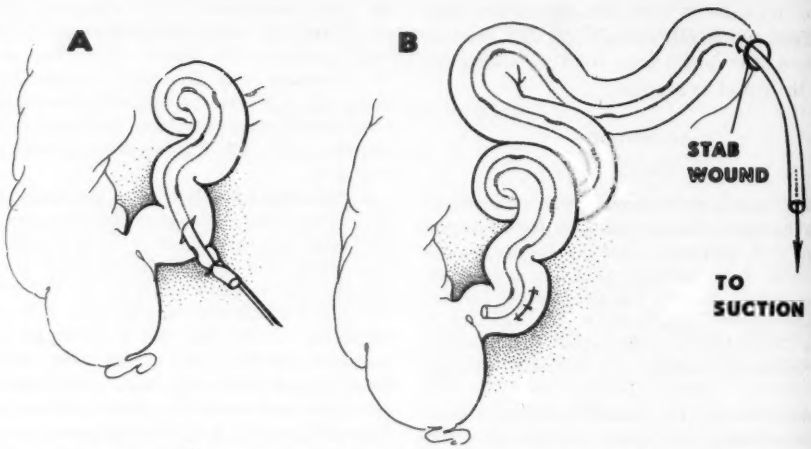

FIG. 2. *A*. The tube, with additional holes at 3-inch intervals, will be pulled through the intestine, left in place and the stripper removed. *B*. The proximal end of the Cantor tube has been brought out through a stab wound and attached to suction. The loop of intestine has been sutured to the peritoneum at the point of exit of the tube. The ileocecal incision in the bowel has been closed.

velopment of some abdominal pain, exploratory laparotomy was carried out on the 8th postoperative day. Dilated loops of small bowel were found in the peritoneal cavity with a moderate amount of semipurulent fluid. There were definite adhesions of the small bowel to the uterus at the scars of the previous myomectomy and of the cesarean section. These were freed, relieving the small bowel obstruction. A small incision was then made in the small bowel above the area of these adhesions and a Cantor tube, with the balloon cut off, passed into the intestine. Holes were cut into its lumen at various points. The tube was passed down to the terminal ileum by tying its end to a vein stripper. At the terminal ileum a second small incision was made in the bowel, the vein stripper removed and the tube allowed to lie free at the ileocecal valve. The upper end of the tube was then brought out at the side of the abdomen as an ileostomy and the loop of intestine sutured to the abdominal wall. The tube was then placed on suction.

Postoperatively, the distention decreased remarkably on suction. The patient was symptom free in 2 or 3 days, her temperature, which had been elevated to 103° preoperatively, fell to normal over the course of the remaining 10 days of her hospitalization. A wound infection developed, culture of which revealed *Staphylococcus aureus*. This gradually healed. The tube was removed on the 10th postoperative day and the patient remained asymptomatic. She has remained so since that time except for one bout of cramping abdominal pain which disappeared spontaneously after a few hours.

Case 2

A 32-year-old white man was hospitalized on September 12, 1960, because of cramping abdominal pain. The pain had been present for the past 2 weeks. There had been previous attacks of similar pain over a period of many years. Two years prior to admission he had had a laparotomy with the lysis of many adhesions in the terminal ileum and lower jejunum. Two weeks prior to admission the pain had recurred, accompanied by occasional vomiting. Although his bowels had moved he had experienced increasing constipation. He stated that he had not passed gas rectally for 2 days prior to admission.

The past history revealed three attacks of renal colic due to stones in the right ureter. He had had an appendectomy, hemorrhoidectomy and the removal of a polyp of the colon in addition to lysis of adhesions noted above.

Physical examination on admission revealed a blood pressure of 130/80, pulse 80. There were two surgical scars on the abdominal wall and there was definite distention in the lower abdomen, particularly in the right lower quadrant. There was some localized tenderness over the transverse right lower quadrant appendectomy scar. Bowel sounds were active and somewhat high pitched in character suggesting partial intestinal obstruction.

Laboratory studies revealed the following:

hemoglobin, 14.3 grams; hematocrit, 43 per cent; leukocytes, 13,200 with normal differential; urinalysis, normal except for 8 to 10 red blood cells per high power frequency; venereal disease, negative.

X-ray studies: kidney, ureter and bladder showed a 6- by 3-mm. calcific density in the lower pole of the right kidney and a 2- by 2-mm. calcific density overlying the left 12th rib, in the vicinity of the left upper kidney. A retrograde pyelogram showed a good outline of the pelvocalyceal systems and ureters bilaterally. The right kidney calculus was in the inferior calyceal system. Flat and upright films of the abdomen showed moderate distention of several loops of small bow l.

Since the patient's symptoms appeared to be due to partial small bowel obstruction, on September 23, 1960, an exploratory laparotomy was carried out through a re-excision of the transverse scar of the right lower quadrant. There were dense adhesions involving the lower half of the moderately distended ileum. These were freed laboriously. When all adhesions had been dissected free, a Cantor tube attached to a vein stripper was threaded through the involved area of the bowel beginning at its upper end. It was pulled down to the ileocecal area where, through a small incision, the vein stripper was removed and the tube allowed to lie in place. The tube was then placed on low suction.

Postoperatively, the patient was relieved of pain and distention. The tube functioned well. There was a brief period of hematuria after operation which cleared spontaneously and was not explained. The tube was removed on the tenth postoperative day. The ileostomy wound healed completely within a few days. The patient has had no further attacks of distention and except for low back pain due to old arthritis of the lumbar spine he has remained relatively symptom free.

Case 3

A 51-year-old widow was hospitalized on January 22, 1960, because of severe colicky abdominal pain distention and vomiting of 18 hours' duration. She had first been admitted to this hospital in March 1959 because of uterine bleeding. Following a hysterectomy she developed severe postoperative ileus, phlebothrombosis with pulmonary embolism, and small bowel obstruction. A laparotomy for lysis of adhesions had been performed, during which the vena cava was ligated. After an extremely stormy course she had been discharged and remained symptom free until the onset of the present illness.

Her present illness had begun 18 hours before admission at which time she developed severe cramping abdominal pain with vomiting. When seen at home the abdomen was distended with high pitched peristaltic rushes. She was hospitalized immediately. Physical examination on admission revealed a temperature of 37.6° C., blood pressure 180/110. The abdomen was moderately distended. One loop of bowel could be felt in the periumbilical area which was tender on palpation. Bowel sounds were diminished but of high pitched character.

Flat abdominal films in the recumbent and upright position showed dilated, fluid-containing loops of small bowel compatible with small bowel obstruction. A diagnosis of mechanical small bowel obstruction was made.

Laboratory studies on admission showed a hematocrit of 45 per cent; hemoglobin, 15.6 grams; leukocytes, 12,650 with 86 per cent segment forms and 6 band forms; lymphocytes, 8 per cent. Urinalysis revealed a specific gravity of 1027 with 1–3 leukocytes, 3–5 erythrocytes. Chlorides were 104 mEq. per L., CO_2, 17.3 mEq. per L.; sodium, 140 mEq. per L.; potassium, 4.4 mEq. per L.

A diagnosis of acute small intestinal obstruction was made. Exploratory laparotomy was carried out through re-excision of the old right rectus scar. There were many loops of distended small bowel. At a point in the midileum several tight bands were found apparently extending to the retroperitoneal area where the vena cava had been ligated 9 months previously. These were divided. The bowel appeared to be viable, and gas was seen to pass from the distended to the deflated loops of intestine. An incision was then made in the dilated portion of the intestine just above the point of obstruction. A Cantor tube was threaded down the small bowel following a vein stripper and was brought down to the ileocecal area. Here, the vein stripper was removed through a small incision and the Cantor tube, with several additional holes placed in it for suction, allowed to lie in place. It was then brought as an ileostomy at the side and placed on suction.

Postoperatively, the patient was completely relieved of pain, the distention subsided and the pulse which had been 110 on admission gradually fell to normal. On the 10th postoperative day an attempt was made to remove the tube in the patient's room, but a silk purse-string stitch which had been placed interperitoneally made this impossible. She was therefore taken to the operating room where this stitch was removed under anesthesia and the tube removed without incident. Her postoperative course was entirely uneventful. When last seen in January 1961 there had been no recurrence of the obstructive symptoms and the patient was in good health.

Case 4

A 60-year-old white woman was hospitalized on May 10, 1960, because of acute abdominal pain and vomiting of 3 days' duration. In May 1959 she had had a small intestinal resection because of a strangulated femoral hernia, and in 1960 a cholecystectomy because of cholelithiasis. She had been well after these operations until 3 days before admission when she had an attack of nausea and vomiting. Twenty-four hours before admission she began to have severe epigastric pain of a colicky nature, accompanied by vomiting. She had been constipated for several months. Twenty-four hours before admission she took an enema with scant results. Since the onset of pain she had complained of weakness and thirst, and because of continuing pain she sought medical attention.

Physical examination on admission revealed a well developed woman in acute abdominal pain. She was very weak and it was difficult to obtain a satisfactory history. Examination was not remarkable except for the abdomen where there were two well healed right paramedian surgical scars, and there was some weakness of the upper scar suggesting an incisional hernia. No masses were palpable in the abdomen. There was no rebound, but there was generalized mild tenderness in the entire upper abdomen. Bowel sounds were high pitched and somewhat hyperactive. The liver edge was palpable one finger below the costal margin.

X-ray examination by flat and upright films of the abdomen revealed markedly distended loops of small bowel with relatively little gas in the large bowel, suggesting mechanical small bowel obstruction. The hemoglobin was 15.2 grams; hematocrit, 44 per cent; leukocytes, 9200 with 83 per cent segmented forms. Blood urea nitrogen was 5.7 mm. per cent; chlorides, 99.8 mEq. per L. Urinalysis was within normal limits.

With a preoperative diagnosis of small intestinal obstruction she was operated upon on the day of admission. An 8- by 10-cm. incisional ventral hernia was found in the upper paramedian incision with dense adhesions to the bowel. There was also a point of obstruction in the right lower quadrant which seemed to be the cause of the acute obstruction. About 8 inches of intestine in this area were necrotic and 12 inches were resected with end-to-end anastomosis. After emptying the distended loops of small bowel by suction, a Cantor tube was threaded through the denuded portion of the bowel by means of a vein stripper. The stripper was removed at the terminal ileum and the tube was brought out through a stab in the left flank. The loop of bowel was sutured to the inside of the peritoneal wall at the site of the stab wound.

Postoperatively, the patient's course was uneventful. Good decompression of the intestine was obtained by means of the tube. The jejunostomy tube was removed on May 23rd and the wound healed primarily. There have been no further symptoms of obstruction.

RESULTS

There has been no recurrence of obstruction in any of the four cases followed for from six months to two years. In one patient it was necessary to use anesthesia to remove the tube because a silk purse string stitch had been used which had to be divided. The tube stab wound healed within a few days in all but one patient who developed a superficial stitch abscess. This healed after removal of a suture.

SUMMARY

A modification of the White inlying tube splint for recurrent small intestinal obstruction has been presented. The tube, passed through the denuded bowel by a vein stripper, was brought out through a lateral abdominal wall stab wound, and placed on suction. Good results were obtained in all four patients in whom it was employed.

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